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MATHEMATICS WE USE

BOOK TWO

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MATHEMATICS WE USE

BOOK TWO

by

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GRADE VIII

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INTRODUCTION

Basic Plan of the Series. The basis of instruction throughout this series of textbooks is (1) the number system and (2) its social significance. Through carefully planned activities the pupil is taught to understand the nature of the number system. This understanding insures a meaningful grasp of the procedures that are presented in the various computational processes. At the same time the pupil is led to see the social significance of mathematics through the study of rich informational units of work dealing with everyday applications of number processes and quantitative procedures. Also, numerous activities are suggested which require pupils to investigate social applications of mathematics in their own communities. This plan insures a well integrated treatment of both phases of the subject.

Scientific Gradation of Subject Matter. To insure successful growth in mathematics ability, the authors have carefully considered the findings of important investigations of grade placement of the topics, and have made extensive surveys of their own, to determine the most satisfactory points at which to present the various elements of the work. As a result, the work of each grade has been considerably simplified and the teaching load greatly reduced. The easier phases of a topic,—for example, percentage,—are presented one year previous to the introduction of phases known to be more difficult to learn. This scientific gradation of subject matter means that topics are spaced through several grades rather than bunched in any one particular grade.

The major phases of the mathematics processes taught in this book are as follows:

1. Finding a number when a per cent of it is given.
2. Finding volumes of certain solids.
3. Informal geometry of size, shape, and position.
4. Indirect measurement by scale drawing.
5. Ratios and square root.
6. Equations and signed numbers.
7. Social applications of mathematics in such topics as investing money, insurance, and taxation.

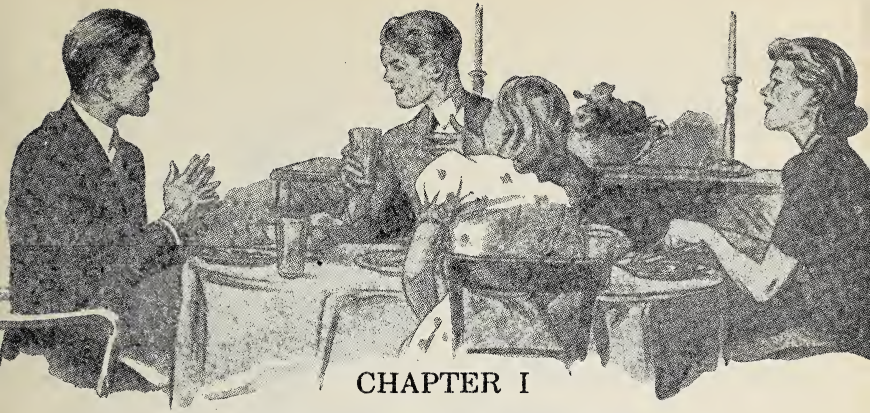
Teaching Procedures That Insure Mastery of Mathematics. These textbooks present an instructional programme that has been thoroughly tested in hundreds of schools. They provide a systematic step-by-step development of the fundamental operations in such a way that each step is both mathematically meaningful and socially significant. Illustrations, pictures, diagrams, and other kinds of visual aids are extensively used to help the pupils to get an insight into the mathematical meaning of the step being presented.

There are many graphs used in this text. A short chapter is devoted to the study of graphs to instruct the pupil how to read and construct a graph. This phase of the subject represents the mathematical view. In many places in the text a graph is used to interpret the data under consideration. This phase of the subject represents the social application of the topic. The presentation of both the mathematical and social applications of a topic represents a scientific and a psychological approach· to the study of mathematics. Besides a psychological approach to the subject, the explanations of procedure are specific and detailed so that the difficulties learners sometimes encounter in the study of mathematics are reduced to a minimum.

Following this concrete development of a step, there are worked-out models for study and solution before practice on the new step is begun. The explanations of procedure are specific and detailed. Diagnostic tests keyed to study helps and remedial practice are provided at frequent intervals to assist the teacher in locating pupils' needs for additional instruction. These tests make it possible for the teacher to provide effectively for individual differences. They also insure intelligent co-operation by the learner toward the correction of any difficulties he may encounter. The skills that have been taught are frequently reintroduced in the units of problem material to insure proper maintenance. Frequent mixed drills of a cumulative nature are also provided. The problems illustrating the applications of the processes are stated in simple language that pupils understand.

ACKNOWLEDGMENTS

GRATEFUL ACKNOWLEDGMENT is made to the following, for permission to use illustrations, business forms, and maps reproduced in this book, and for supplying essential data; The Bank of Montreal, Winnipeg Hydro-Electric System, Trans-Canada Air Lines, Canadian Pacific Air Lines, Canadian National Telegraphs, Saskatchewan Pool Elevators, Limited, Manitoba Telephone System, Plan for Hospital Care.



CHAPTER I

MATHEMATICS IN THE NEWS

During the evening meal, the Taylor family usually discusses things of interest which have happened during the day. One night Henry brought up a question which had been asked in his arithmetic class.

HENRY: "If you were to drive your car from one town to another and you did not know the distance between the two towns, how could you find the **approximate** distance?"

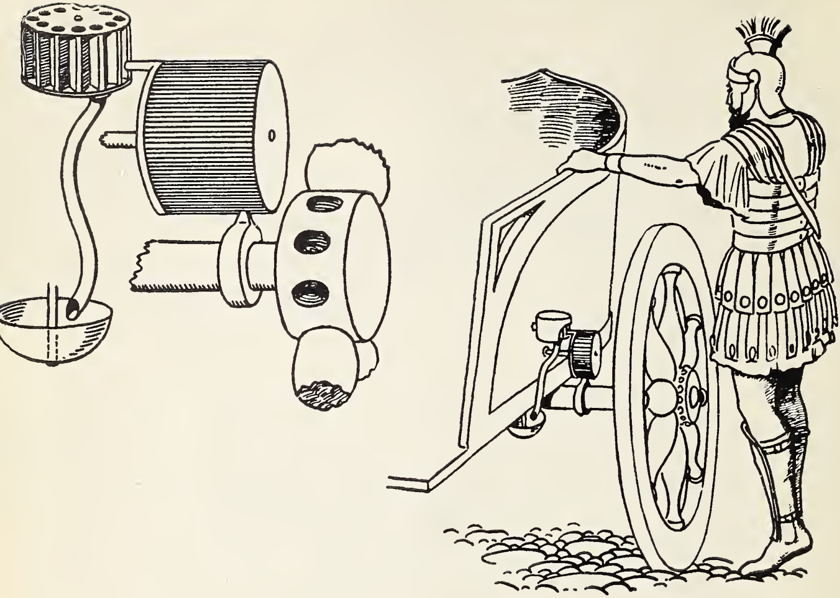
ALICE: "That's easy. I would set the speedometer at zero before starting and measure the distance."

MOTHER: "I would find the distance from a road map."

FATHER: "You have mentioned the best ways: but I could **estimate** the distance. I drive at an average speed of 35 miles an hour, so I would multiply that rate by the length of time spent in going from one town to the other."

HENRY: "We mentioned all of those methods in class and we had some others none of you has given."

Name other ways to find the distance between two places.



THE SPEEDOMETER IS BORN

Father: "Let me ask you something. How did the ancients, the Romans for example, measure distances? They had no automobiles or speedometers."

Henry: "This will surprise you. Jack brought in a news item which showed that the Romans used a speedometer. They called it an **odometer.** The name means 'measure the way.' "

Mother: "That is very interesting. I thought the speedometer was invented soon after the automobile. The Romans must have used theirs on some other vehicle, probably the chariot. Tell us what it was like."

HENRY: "The chariot wheels were about four feet in diameter. A small metal rod extended vertically from the hub. Every time the wheel made a complete turn, this rod would move another wheel one notch. This second wheel was fastened to the body of the chariot, and had around its rim 400 notches or cogs, one of which was longer than the others.

"Each time the cogwheel revolved, the long notch moved a disc placed at right angles to the wheel. The disc had holes which contained small pebbles. When the disc wheel moved one notch, a pebble dropped from it to a small container. Thus, if the wheel turned 8 notches during a journey, there would be 8 pebbles in the container. The number of pebbles in the container represented the number of Roman **miles** the chariot had travelled."

ALICE: "I don't see how that would measure the distance very accurately."

HENRY: "The wheel of the chariot was 4 feet in diameter. The distance travelled in one turn of the wheel would be a little more than three times the diameter or about $12\frac{1}{2}$ feet.

"The second wheel had 400 notches or cogs. As the chariot travelled $12\frac{1}{2}$ feet each time one notch moved, a complete turn of the cogwheel meant that the chariot had travelled 5000 feet ($400 \times 12\frac{1}{2}$).

"Every time the chariot was driven 5000 feet, the disc would drop a pebble into the container. Thus each pebble showed that the chariot had travelled 5000 feet. The Roman mile contained 1000 **paces,** or about 5000 feet."

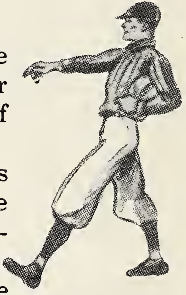
FATHER: "That was an interesting lesson. It makes one realize how arithmetic helps us to understand things which we discuss or read."

MEASURING BY ODOMETER

1. Why was the diameter of the large wheel multiplied by a number a little greater than 3?

2. Was the distance the chariot wheel travelled in one complete turn exactly 12½ feet? Explain.

3. Would the odometer give a more, or less, accurate measure of the distance between two places than could be found by guessing the distance?

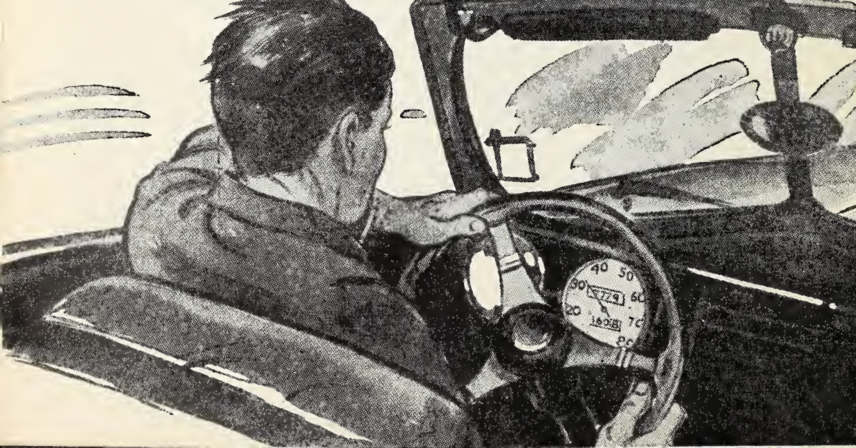


4. How do you think the accuracy of an odometer would compare with that of a modern speedometer?

5. The Roman "pace" was about five feet. Does a pace still represent the same distance?

6. When a football referee penalizes a team 5 yards, how does he measure off the distance?

*7. You may wish to make a model of an odometer. The model does not need to contain 400 cogs in order to illustrate the principle.



THE SPEEDOMETER FOR ACCURACY

The speedometer measures distance reasonably accurately to one tenth of a mile. The odometer measured only to the nearest mile. This improvement in measurement was made possible by the use of machinery which can make instruments having more space-divisions to a unit.

Instead of one division, or pebble, to a mile, the modern speedometer measures a unit of length one tenth as great. And the speedometer is more nearly exact than the odometer because of better tools and machines used in constructing the parts of the speedometer. As more accurate means for measuring are invented, a more nearly perfect product is possible.

1. What is meant by measuring to the nearest mile? to the nearest tenth of a mile? to the nearest foot? to the nearest inch?

2. Give these measurements correct to the nearest whole unit of measure: *a.* $6\frac{3}{4}$ ft.; *b.* $8\frac{7}{8}$ yd.; *c.* $2\frac{1}{4}$ in.; *d.* $6\frac{1}{2}$ gal.; *e.* $7\frac{2}{3}$ yd.; *f.* $1\frac{3}{5}$ ton; *g.* $4\frac{3}{8}$ oz.; *h.* $9\frac{7}{10}$ mi.

3. What is the total mileage recorded by the speedometer (page 4)?

4. What is the exact trip mileage? the trip mileage to the nearest mile?

5. At what speed is the car travelling? How much less than the speed limit in your province is this?

6. If "miles an hour," as recorded on the speedometer, is the average speed at which this car is driven, what was the driving time for the trip (to the nearest hour)?

*7. Name five jobs in which a high degree of accuracy in measurement is required.

*8. A salesman, demonstrating an automobile, spoke of it as "mechanically perfect." What did he mean?

HOW WELL DO YOU USE THE TOOLS OF ARITHMETIC?

Numbers are sometimes called the **tools of arithmetic.** This test gives you a chance to measure your understanding and use of these tools.

First copy the examples, leaving plenty of space for your work. You will be allowed 15 minutes to work the examples after they have been copied.

1. $9\frac{7}{8} + 4\frac{3}{4} + 1\frac{1}{2}$
2. $9\frac{5}{6} + 4\frac{1}{2} + 8\frac{2}{3}$
3. $9\frac{1}{6} - 4\frac{3}{4}$
4. $71\frac{3}{4} - 16\frac{3}{8}$
5. $.405 - .389$
6. $8.75 - 3.67$
7. 307×608
8. $4\frac{5}{6} \times 48$
9. $468 + 736 + 509 + 674 + 925 + 780$
10. Find the sum of: .98, .85, 3.75, 97.00, .09, and .72.
11. Multiply $51\frac{7}{8}$ by $4\frac{3}{4}$.
12. How much is 8.75×9.6?
13. Multiply $4.56 \times .08$.
14. Divide 9125 by 16. Check your work.
15. How much is $4\frac{1}{2} \div 6$?
16. Divide $3\frac{1}{3}$ by $1\frac{1}{3}$. Check your work.
17. How much is $4158 \div .09$?
18. Divide .0756 by 2.7.
19. 25% of 675 = ?
20. 75 = ? % of 225

What Your Scores Mean (Number correct)

Unsatisfactory	Fair	Good	Excellent
Less than 15	15—17	18 19	20

If you made an error on any kind of example in this test, you should take the diagnostic test in that process to find if you should review the process.

HOW TO USE THE DIAGNOSTIC TESTS

The diagnostic tests that will help you to find the practice which you need in the different processes are listed by page number below.

	WHOLE NUMBERS	FRACTIONS	DECIMALS
Addition	Page 8	Page 15	Page 20
Subtraction	" 8	" 15	" 20
Multiplication	" 9	" 16	" 21
Division	" 9, 13	" 18	" 25

The diagnostic tests in percentage are on page 58.

Follow carefully the directions given for each diagnostic test. A good plan is to try all the tests. You may find some part of a process that you should review even though you made no error in that process on the test, page 6.

MAGIC SQUARES

A magic square, as you recall, is made by arranging numbers in a square in such a manner that the sum of the numbers in each row, each column, and along each of the diagonals is the same.

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

The magic square shown is very famous. It is found on a painting entitled MELANCOLIA, by Dürer.

1. What is the sum of the numbers in each row? in each column?

2. The numbers along one diagonal are 16, 10, 7, and 1. What is their sum? What is the sum of the numbers along the other diagonal?

3. How many cells (small squares) are in the magic square?

DIAGNOSTIC TEST IN ADDITION

Do not copy the examples on this page. Write each sum on a folded paper placed beneath the example.

	a	*b*	*c*
I.	4	7	3
	8	6	8
	5	9	5
	7	4	9
	9	5	4
II.	46	79	86
	38	56	53
	95	83	40
	67	49	98
	48	85	39

	a	*b*	*c*
III.	269	515	289
	471	720	870
	118	124	692
	304	309	802
	760	210	926
	735	462	524
IV.	559	708	300
	66	6	104
	955	1423	207
	38	56	806
	694	341	1302
	87	3486	401

If you missed more than one example in any of the four groups, turn to pages 295–296 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN SUBTRACTION

Write on folded paper placed below the example.

	a	*b*	*c*
I.	744	563	328
	228	127	165
II.	723	916	835
	156	278	496
III.	640	406	702
	308	198	305

	a	*b*	*c*
IV.	723	812	504
	48	9	7
V.	6703	9130	7250
	6507	8690	6308
VI.	7000	6030	5010
	1392	492	19

If you missed more than one example in any group, turn to pages 296–297 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN MULTIPLICATION

Turn to page 295 and check your knowledge of the multiplication facts before you take the following test.

	a	b	c		a	b	c
I.	324 8	647 7	519 6	IV.	457 203	706 504	6004 308
II.	605 4	609 9	9008 5	V.	870 950	910 460	490 520
III.	641 20	738 60	549 30	VI.	\$2.75 482	\$5.98 576	974 493

If you missed more than one example in any group, turn to pages 297–298 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN DIVISION

Divisor—One-Figure

Turn to page 295 and check your knowledge of the 90 even-division facts before you take the following test.

	a	b	c		a	b	c
I.	$7\overline{)863}$	$4\overline{)2613}$	$5\overline{)927}$	III.	$6\overline{)3613}$	$4\overline{)720}$	$2\overline{)5900}$
II.	$7\overline{)4031}$	$9\overline{)2303}$	$8\overline{)5102}$	IV.	$6\overline{)2761}$	$7\overline{)5100}$	$6\overline{)7205}$

If you missed more than one example in any group, turn to pages 298–299 for practice exercises keyed to this test.

CHECKING DIVISION

1. Divide 4062 by 7 and check the solution by two different methods.

2. Walter divided 51,035 by 9. The result was 567 with a remainder of 5. He checked the solution as shown. Where is the error in this check?

$$\begin{array}{r}567\\ \times 9\\ \hline 5103\\ +5\\ \hline 51035\end{array}$$

PAYING PEOPLE FOR THE WORK THEY DO

There are two main methods of paying the wage-earner for the work he does. The first is called "time payments"; the second is called "payment by results." Under the time-payment plan, the worker's wages depend upon the time he spends on his employer's business. Under the "payment-by-results" plan, the worker is paid according to the amount he produces. Sometimes these plans are combined in various ways and the worker is paid both according to time and amount.

How the "Time-payment" Plan Works:

1. In one large eastern city carpenters are paid $1.10 an hour for an 8-hour day. How much do they receive for 5 days' work?

2. For working more than 8 hours a day they are paid "double time" for overtime work. How much would a carpenter receive for working 10 hours in one day?

3. In another city plasterers are paid $1.50 an hour for a 7-hour day and "time and a third" for overtime. Under this plan how much does a plasterer receive who works 9½ hours in one day?

4. In a certain city labourers received $2.60 for an 8-hour day. How much did they receive for a 40-hour week?

5. Girls in a certain department store received $16.80 a week for 40 hours' work. How much did they receive for an hour? They had to work overtime without additional pay.

★6. In that city all ordinary labourers, employed by one firm, regardless of differences in their strength and the amount of work they did, were paid the same wages for an hour's work. Is this system a fair one?

How the "Payment-for-results" Plan Works.

1. In St. Catharines, Ontario, a farmer paid workers $2\frac{1}{4}$ cents a basket for picking grapes. John averaged 170 baskets a day. Arthur picked only 130 baskets. How much more than Arthur did John receive for a day's work?

2. Harold and Fred sold 10-cent magazines for which they paid the dealer $6\frac{1}{2}$ cents. One week Harold sold 40 magazines and Fred sold 28. How much less than Harold did Fred earn?

3. A barber paid his helper 25¢ of the 50¢ received for a haircut, 15¢ of the 25¢ received for a shave, 30¢ of the 50¢ received for a shampoo, and one half of all other money received for work done. One week the helper was paid for 52 haircuts, 60 shaves, 45 shampoos, and his share of the $6.20 received for other work he did. How much did the helper receive? How much did the barber receive?

4. One clothing merchant pays his salespeople one tenth of all money taken in from their sales. Below are given the sales for a week by two salesmen. How much did each one earn each day? during the week?

	MR. BOWEN	MR. BARTLEY
Monday	$25.00	$50.00
Tuesday	18.50	46.75
Wednesday	39.25	60.25
Thursday	16.75	97.50
Friday	40.00	130.25
Saturday	55.50	225.00

***5.** Workers in many kinds of factories are paid "by the piece." Can you find examples in local factories of how people are paid for the results of their work? Miners are often paid according to the amount of coal they produce.

COMBINING THE TWO PLANS

In many concerns the two plans of payment discussed on pages 10 and 11 are combined in various ways.

1. In one barber shop, each barber is guaranteed at least $18 a week. In addition to this amount he is paid one half of all money taken in for his work above $30. How much could a barber receive in this barber shop if his receipts for three weeks were $28? $30? $52?

2. One farmer offered to pay persons who picked his raspberries $.40 a crate or $2.00 a day. One worker on the day rate picked only 4 crates. How much more did he receive than he would have received if he had been paid by the crate?

3. Another worker picked 8 crates of berries. How much more did he receive when paid by the crate than he would have received if paid by the day? Would you cut the rate of pay for this worker if you were the farmer?

4. A clothing merchant agreed to pay his salespeople $18 a week and one tenth of all sales over $300. This is called a "bonus" plan. One clerk had sales during the week amounting to $270. Another had sales amounting to $520. How much more did the second clerk receive than the first clerk? Why shouldn't both clerks be paid the same amount?

5. An automobile dealer paid each of his salesmen $20 a week and in addition one twentieth of the money received for the cars each one sold. According to this plan how much would a salesman receive who sold 3 sedans at $1625 each, a truck for $1800, and 2 roadsters at $1550 each?

***6.** Try to find examples of ways like those described above in which people in your locality are paid.

DIAGNOSTIC TEST IN DIVISION

Divisor—Two-or-More-Figures

If there is a remainder in any of the following examples, write it as a remainder, not as a fraction.

	a	b	c		a	b
I.	24)576	73)3980	54)872	V.	28)1832	39)2882
II.	24)9631	35)7140	54)5040	VI.	16)9123	17)8534
III.	23)2087	38)3434	56)5072	VII.	324)8147	427)40982
IV.	47)1326	24)1372	48)2175	VIII.	268)13642	158)90970

If you missed more than one example in any group, turn to pages 299–300 for practice exercises keyed to this test.

A TOPSY-TURVY MAGIC SQUARE

Below is a "topsy-turvy" magic square. When the page is held in the usual position or in an inverted position, a magic square is formed.

1. What is the sum of the numbers in the square in each row? in each column? in each diagonal?

2. Invert your book. What is the sum of the numbers in the square in each row? in each column? in each diagonal?

3. How many different digits are used in the square? Why could not all of the digits be used in a magic square of this kind?

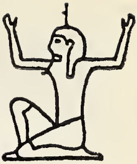
2673

696	*611*	*989*	*668*
988	*669*	*691*	*616*
661	*986*	*618*	*699*
619	*698*	*666*	*981*

2964

By Royal V. Heath

UNDERSTANDING LARGE NUMBERS



The symbols used by the ancient Egyptians to represent numbers were not the same as ours. To express a million, they drew a picture of a man, very much astonished. Why do you think that was an appropriate symbol?

1. Find the number of minutes in a year of 365 days. How much more or less than a million is it?

2. How many thousands does it take to make a million? a billion?

3. How many millions does it take to make a billion?

4. What difference, if any, is there between a thousand millions and a billion?

5. What is the largest number which may be written with six figures? the smallest?

6. In some European countries a billion means a million millions. Does it have the same or a different meaning in this country?

7. There are about three quarters of a billion people in North and South America and Europe. A billion dollars would supply each person with about how much money?

*8. Have as many or more than a billion minutes passed from the beginning of the Christian era to the end of the present year? to the beginning of this century?

*9. Does your province have a population of more, or, less, than a million? How much more or less?

*10. Astronomers measure the distance to many stars in **light years.** A light year, as you recall, is the distance which light travels in one year at the rate of about 186,000 miles a second. Show that a light year is about six trillion miles. Write this number with figures.

DIAGNOSTIC TEST IN ADDITION OF FRACTIONS

Copy and add the following:

	a	*b*	*c*
I.	$\frac{5}{8}$ $\frac{7}{8}$	$\frac{5}{9}$ $\frac{7}{9}$	$3\frac{7}{10}$ $8\frac{1}{10}$
II.	$\frac{3}{4}$ $\frac{7}{8}$	$\frac{9}{16}$ $\frac{5}{8}$	$9\frac{1}{2}$ $4\frac{5}{12}$
III.	$\frac{1}{3}$ $\frac{1}{2}$	$\frac{2}{5}$ $\frac{1}{4}$	$5\frac{1}{3}$ $7\frac{1}{4}$
IV.	$\frac{5}{6}$ $\frac{3}{4}$	$\frac{1}{8}$ $\frac{5}{6}$	$6\frac{4}{9}$ $9\frac{1}{6}$
V.	$4\frac{2}{3}$ $5\frac{3}{4}$	$6\frac{4}{5}$ $1\frac{1}{2}$	$7\frac{2}{3}$ $\frac{3}{4}$
VI.	$9\frac{1}{6}$ $1\frac{7}{8}$	$2\frac{5}{6}$ $\frac{3}{4}$	$4\frac{3}{8}$ $1\frac{5}{6}$
VII.	$3\frac{5}{16}$ $2\frac{7}{8}$ $9\frac{1}{4}$	$1\frac{2}{3}$ 7 $2\frac{5}{6}$	$1\frac{1}{12}$ $5\frac{7}{12}$ $\frac{3}{4}$
VIII.	$2\frac{5}{6}$ $\frac{7}{8}$ $\frac{3}{4}$	$8\frac{1}{4}$ 9 $3\frac{5}{6}$	$7\frac{1}{4}$ $2\frac{5}{6}$ $3\frac{1}{2}$

If you missed more than one example in any group, turn to pages 300–302 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN SUBTRACTION OF FRACTIONS

Copy and subtract the following:

	a	*b*	*c*
I.	$\frac{3}{4}$ $\frac{1}{2}$	$\frac{7}{8}$ $\frac{1}{4}$	$6\frac{9}{16}$ $4\frac{3}{8}$
II.	$\frac{5}{6}$ $\frac{1}{3}$	$\frac{11}{12}$ $\frac{1}{3}$	$9\frac{1}{2}$ $3\frac{1}{12}$
III.	$\frac{5}{6}$ $\frac{3}{4}$	$\frac{3}{4}$ $\frac{2}{3}$	$8\frac{7}{8}$ $2\frac{5}{6}$
IV.	8 $3\frac{5}{9}$	6 $5\frac{7}{8}$	1 $\frac{7}{12}$
V.	$9\frac{1}{3}$ $4\frac{2}{3}$	$6\frac{1}{4}$ $2\frac{3}{4}$	$4\frac{2}{5}$ $3\frac{4}{5}$
VI.	$9\frac{1}{4}$ $7\frac{7}{8}$	$7\frac{1}{3}$ $2\frac{5}{6}$	$6\frac{1}{2}$ $\frac{5}{8}$
VII.	$6\frac{1}{4}$ $2\frac{1}{3}$	$9\frac{1}{2}$ $5\frac{2}{3}$	$7\frac{2}{3}$ $\frac{3}{4}$
VIII.	$15\frac{5}{8}$ $6\frac{5}{6}$	$11\frac{3}{4}$ $8\frac{5}{6}$	$4\frac{1}{6}$ $3\frac{5}{8}$

If you missed more than one example in any group, turn to pages 302–303 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN MULTIPLICATION OF FRACTIONS

Copy and multiply the following:

	a	*b*	*c*
I.	$\frac{5}{6} \times 7$	$\frac{3}{4} \times 9$	$\frac{5}{12} \times 11$
II.	$\frac{3}{4} \times 14$	$\frac{7}{8} \times 30$	$\frac{9}{10} \times 25$
III.	$8 \times \frac{3}{4}$	$12 \times \frac{7}{8}$	$6 \times \frac{7}{8}$
IV.	$4\frac{1}{2} \times 9$	$2\frac{3}{4} \times 14$	$5\frac{1}{6} \times 15$
V.	$\frac{3}{4} \times \frac{7}{8}$	$\frac{5}{8} \times \frac{3}{16}$	$\frac{4}{9} \times \frac{5}{7}$
VI.	$\frac{5}{6} \times \frac{8}{9}$	$\frac{3}{4} \times 7\frac{2}{3}$	$4\frac{5}{6} \times \frac{9}{10}$
VII.	$9\frac{1}{4} \times 6\frac{1}{2}$	$4\frac{1}{5} \times 3\frac{1}{7}$	$2\frac{1}{2} \times 6\frac{2}{3}$
VIII.	$2 \times 1\frac{1}{4} \times 3\frac{1}{2}$	$4\frac{2}{3} \times 2\frac{5}{6} \times 3$	$6\frac{1}{4} \times 3\frac{1}{2} \times 4$

If you missed more than one example in any group, turn to pages 303–304 for practice exercises keyed to this test.

FINDING ERRORS IN MULTIPLICATION

1. Copy and solve the following examples. Compare your work with that given and find the error in each example.

a. $\frac{\cancel{3}}{\cancel{4}} \times \frac{\cancel{4}}{\cancel{3}} = 0$

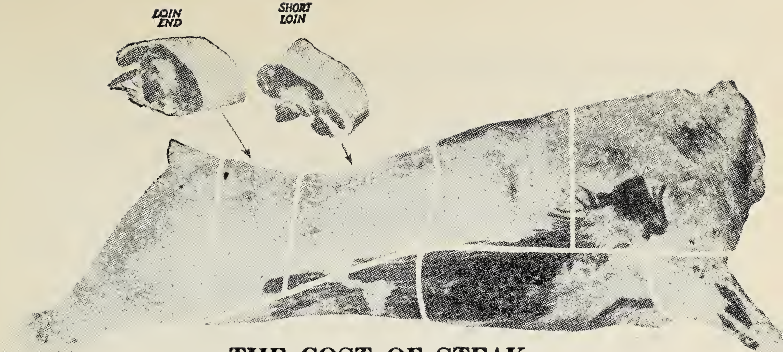
b. $\frac{\cancel{5}}{6} \times \frac{7}{\underset{2}{\cancel{10}}} = \frac{7}{2} = 3\frac{1}{2}$

c. $8\frac{1}{4} \times 3\frac{1}{3} = \frac{\overset{11}{\cancel{33}}}{4} \times \frac{10}{\cancel{3}} = \frac{110}{4} = 25$

d. $4\frac{1}{2} \times 6 \times 1\frac{1}{4} = \frac{\overset{3}{\cancel{9}}}{2} \times \frac{\cancel{6}}{2} \times \frac{5}{4} = \frac{15}{16}$

*2. From your study of the errors in the previous examples, state why all examples in multiplication of fractions should be written in the following form:

$$\frac{3}{4} \times \frac{7}{9} = \frac{3 \times 7}{4 \times 9}$$



THE COST OF STEAK

A group of people who operate restaurants recently had a demonstration showing the cost of highest-grade steak. This steak is taken from that part of the beef which is called the **loin.** The loin from half a beef was cut into the different parts that could be sold. The weight of each part and the retail price a pound is given in the table:

a.	$5\frac{1}{4}$ lb. fat . . . .at	3¢ lb	*d.*	$2\frac{1}{4}$ lb. waste . . . . .at	4¢ lb.
b.	$6\frac{1}{2}$ lb. bones . . . "	2¢ "	*e.*	$4\frac{1}{4}$ lb. tenderloin . "	52¢ "
c.	$9\frac{1}{2}$ lb. flank . . . "	9¢ "	*f.*	$11\frac{1}{2}$ lb. sirloin . . . . "	48¢ "

1. Find the total weight of the loin of half a beef.
2. Find the cost of each part of the loin.
3. What is the total cost of the entire half of the loin?
4. What is the average cost a pound of the loin of beef?
5. The waste, fat, and bones represent what part of the entire loin?
6. If there was the same amount of loin in each half of this beef, how much loin was in the beef?
7. The average serving of a sirloin steak weighs 14 ounces. Find the cost of a steak of this size at 48¢ a pound.
8. What would be the cost of a tenderloin steak weighing 14 ounces at 52¢ a pound?

DIAGNOSTIC TEST IN DIVISION OF FRACTIONS

In division of fractions, be sure to invert the divisor. Copy and divide the following:

	a	*b*	*c*	*d*
I.	$\frac{3}{4} \div 2$	$\frac{7}{8} \div 3$	$\frac{3}{5} \div 2$	$\frac{9}{10} \div 4$
II.	$\frac{4}{5} \div 2$	$\frac{6}{7} \div 4$	$\frac{8}{9} \div 6$	$\frac{15}{16} \div 3$
III.	$8 \div \frac{2}{3}$	$12 \div \frac{3}{4}$	$34 \div \frac{4}{9}$	$69 \div \frac{6}{7}$
IV.	$\frac{2}{3} \div \frac{3}{4}$	$\frac{7}{8} \div \frac{5}{9}$	$\frac{4}{5} \div \frac{3}{8}$	$\frac{5}{6} \div \frac{4}{7}$
V.	$4 \div 5\frac{1}{5}$	$3 \div 1\frac{1}{2}$	$5 \div 1\frac{1}{4}$	$4 \div 6\frac{2}{3}$
VI.	$2\frac{1}{2} \div 3\frac{1}{4}$	$6\frac{2}{3} \div 4\frac{5}{6}$	$4\frac{1}{2} \div 6\frac{1}{4}$	$8\frac{1}{3} \div 4\frac{5}{9}$
VII.	$1 \div 2$	$8 \div 9$	$15 \div 18$	$36 \div 48$

If you missed more than one example in any group, turn to pages 304–305 for practice exercises keyed to this test.

FINDING ERRORS IN DIVISION

1. Copy and solve the division examples below. Compare your work with that given and find the error in each example.

a. $$\frac{3}{4} \div \frac{2}{3} = \frac{3}{4} \times \frac{2}{3} = \frac{\overset{1}{\cancel{3}} \times \overset{1}{\cancel{2}}}{\underset{2}{\cancel{4}} \times \underset{1}{\cancel{3}}} = \frac{1}{2}$$

b. $$\frac{5}{6} \div \frac{3}{8} = \frac{6}{5} \times \frac{3}{8} = \frac{\overset{3}{\cancel{6}} \times 3}{5 \times \underset{4}{\cancel{8}}} = \frac{9}{20}$$

c. $$2\frac{1}{4} \div 3 = \frac{9}{4} \div 3 = \frac{9 \times 3}{4} = \frac{27}{4} = 6\frac{3}{4}$$

*2. Clifford knew that $4 \div \frac{2}{3} = 6$; but he did not understand why the result should be greater than 4, the number divided. State why it is greater.

PLANNING A CLASS PARTY

Some girls of the Kent School decided to bake cakes for a class party. They used the following recipe:

½ cup butter
1 cup sugar
1½ cup cake flour
½ cup milk
2 squares chocolate
2 eggs
1 tsp. vanilla
1 tsp. baking powder

The recipe made a cake 9 inches in diameter.

1. By measurement with a string, the circumference (distance around) of the cake was found to be about 28 inches. Tell why this was correct.

2. If each cake was to serve ten people, how many cakes were required for a group of 60 pupils?

3. One cup of butter weighs about ½ pound. Find the cost of the butter at 42¢ a pound.

4. One cup of sugar weighs about ½ pound. Find the cost of the sugar at 9¢ a pound.

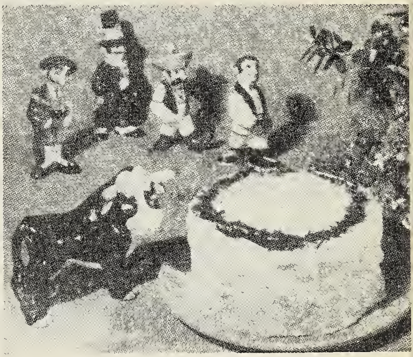
5. Find the cost of the milk at 15¢ a qt. (5 cups—1 qt.).

6. If the eggs cost 45¢ a dozen, find the cost of the eggs used in the cakes.

7. The girls bought a package of cake flour containing 2 pounds 12 ounces for 33¢. If a cup of flour weighs ¼ pound, how much flour was left over?

8. The chocolate and vanilla cost 50¢. Find the total cost of making the cakes.

★9. How much would it cost you to make one of the cakes?



DIAGNOSTIC TEST IN ADDITION OF DECIMALS

Do not copy the examples. Write the sums on a folded paper placed below the examples.

	a	b	c		a	b	c
I.	.6	.3	.9	III.	4.3	5.6	3.8
	.8	.5	.4		8.8	1.9	0.4
	.9	.7	.8		1.9	0.5	0.7
II.	.07	.45	.60	IV.	5.35	7.46	.050
	.04	.78	.30		0.46	3.85	.750
	.05	.96	.50		1.90	0.96	.450

If you missed more than one example in any group, turn to page 305 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN SUBTRACTION OF DECIMALS

Copy and subtract the following:

	a	b	c		a	b	c
I.	.85	.40	.60	III.	6.00	5.80	3.50
	.25	.25	.38		1.47	1.56	0.95
II.	9.6	5.5	7.5	IV.	6.75	1.00	1.315
	2.6	3.8	4.5		6.70	0.93	1.307

If you missed more than one example in any group, turn to page 306 for practice examples keyed to this test.

QUESTIONS TO ANSWER

1. Jim said, "Adding and subtracting decimals is like adding and subtracting whole numbers except that the decimal point is written in the result." Why was he correct? Where is the point always written in the result?

★2. Harry saw the following puzzle problem: .4 + .044 + 4 + .0044 + 40. Find the sum of these numbers.

PLACING THE POINT IN THE PRODUCT

Copy each product and place the decimal point in the correct position, inserting zeros if necessary.

1.	**2.**	**3.**	**4.**	**5.**	**6.**
4.5	.96	.04	54	48	.81
7	1	2	.5	.4	.2
315	96	8	270	192	162

7.	**8.**	**9.**	**10.**	**11.**	**12.**
.08	1.4	.25	.1	523	.83
.08	1.4	.25	.1	.01	70
64	196	625	1	523	5810

13.	**14.**	**15.**	**16.**	**17.**	**18.**
1.1	58	.02	.67	9.8	.33
.1	.001	.2	.05	1.5	.003
11	58	4	335	1470	99

19. Multiply each of the following numbers by 10, 100, and 1000: *a.* .76; *b.* .035; *c.* 8.4; *d.* 63.7; *e.* .0001.

20. Complete the statements: To multiply a decimal by 10, move the point (?); to multiply by 100, move the point (?); to multiply by 1000, move the point (?).

DIAGNOSTIC TEST IN MULTIPLICATION OF DECIMALS

Copy and multiply the following:

	a	*b*	*c*		*a*	*b*	*c*
I.	.45	.38	4.8	IV.	7.5	3.47	46.5
	3	6	6		1.5	1.5	3.8
II.	.07	.01	3.05	V.	.83	7.06	.025
	6	5	2		.06	.04	.03
III.	65	620	875	VI.	7.65	83.4	72.549
	.6	.4	.02		10	100	1000

If you missed more than one example in any group, turn to pages 306–307 for practice exercises keyed to this test.

STUDY HELPS IN DIVISION OF DECIMALS

1. Bill had a piece of wire 8.6 feet long which he cut into two equal pieces. What was the length of each piece?

$$\begin{array}{r} 4.3 \\ 2\overline{)8.6} \end{array}$$

Is the decimal point in the quotient placed correctly or incorrectly? Why?

The length of each piece was 4.3 feet.

2. How many pieces of ribbon, each of which is 1.5 yards long, can be cut from a piece 6 yards long?

$$1.5\overline{)6} = \begin{array}{r} 4 \\ 15\overline{)60} \\ \underline{60} \end{array}$$

To change the divisor to a whole number, multiply both the divisor and the number divided by 10.

3. How many dresses requiring 2.5 yards of cloth each may be made from 7.5 yards?

$$2.5\overline{)7.5} = \begin{array}{r} 3 \\ 25\overline{)75} \\ \underline{75} \end{array}$$

How were 2.5 and 7.5 changed?

4. What is the smallest number each of the following numbers may be multiplied by to make it a whole number: *a.* 4.6? *b.* .52? *c.* 3.68? *d.* 1.755? *e.* .625? *f.* .7? *g.* 1.25?

5. Copy, and place the point correctly in the quotient:

a. $\begin{array}{r} 21 \\ 4\overline{)8.4} \end{array}$ *b.* $\begin{array}{r} 12 \\ 6\overline{).72} \end{array}$ *c.* $\begin{array}{r} 19 \\ 5\overline{).95} \end{array}$ *d.* $\begin{array}{r} 2 \\ .2\overline{)4} \end{array}$

e. $\begin{array}{r} 10 \\ .1\overline{)10} \end{array}$ *f.* $\begin{array}{r} 23 \\ .3\overline{)6.9} \end{array}$ *g.* $\begin{array}{r} 2 \\ .45\overline{)90} \end{array}$ *h.* $\begin{array}{r} 7 \\ 1.2\overline{)8.4} \end{array}$

i. $\begin{array}{r} 4 \\ .36\overline{)14.4} \end{array}$ *j.* $\begin{array}{r} 10 \\ .56\overline{)560} \end{array}$ *k.* $\begin{array}{r} 1 \\ .01\overline{)1} \end{array}$ *l.* $\begin{array}{r} 4 \\ 2.4\overline{)9.6} \end{array}$

6. Divide .16 by 8.

$\begin{array}{r} .02 \\ 8\overline{).16} \end{array}$ The zero is placed in the quotient before the 2 to indicate that there are no tenths in the result. How can you check the result to prove that it is correct?

7. Copy each example and place the point correctly in the quotient.

a. $\begin{array}{r} 3 \\ 4\overline{).12} \end{array}$ *b.* $\begin{array}{r} 31 \\ 7\overline{).217} \end{array}$ *c.* $\begin{array}{r} 41 \\ 9\overline{).369} \end{array}$ *d.* $\begin{array}{r} 6 \\ 14\overline{).084} \end{array}$

e. $\begin{array}{r} 3 \\ 7.6\overline{)228} \end{array}$ *f.* $\begin{array}{r} 4 \\ 98\overline{).0392} \end{array}$ *g.* $\begin{array}{r} 2 \\ 5.4\overline{).0108} \end{array}$ *h.* $\begin{array}{r} 26 \\ 26\overline{).0676} \end{array}$

8. Divide the following and check the result by multiplication:

a. $3\overline{).15}$ *b.* $5\overline{).125}$ *c.* $.5\overline{).125}$ *d.* $6\overline{).012}$

e. $.004\overline{)8.}$ *f.* $5.1\overline{).306}$ *g.* $.01\overline{).1}$ *h.* $4.03\overline{)523.9}$

9. The following examples have the decimal point placed correctly in the quotient. Tell how the position of the point was found.

a. $\begin{array}{r} .08 \\ 6\overline{).48} \end{array}$ *b.* $\begin{array}{r} .025 \\ 4\overline{).1} \end{array}$ *c.* $\begin{array}{r} .31 \\ 25\overline{)7.75} \end{array}$ *d.* $\begin{array}{r} .5 \\ 28\overline{)14} \end{array}$

e. $\begin{array}{r} 2 \\ 2.5\overline{)5} \end{array}$ *f.* $\begin{array}{r} 165 \\ 1.6\overline{)264} \end{array}$ *g.* $\begin{array}{r} 2.6 \\ 3.6\overline{)9.36} \end{array}$ *h.* $\begin{array}{r} 4.3 \\ .04\overline{).172} \end{array}$

i. $\begin{array}{r} .21 \\ 3.2\overline{).672} \end{array}$ *j.* $\begin{array}{r} .025 \\ 6.5\overline{).1625} \end{array}$ *k.* $\begin{array}{r} .05 \\ 6.8\overline{).34} \end{array}$ *l.* $\begin{array}{r} .075 \\ 12\overline{).9} \end{array}$

WAYS OF EXPRESSING A NUMBER

You know that 1 is equal to 10 tenths, 100 hundredths, or 1000 thousandths. Then 1 may be written as 1.0, 1.00, or 1.000.

1. There are how many tenths in 5? in 4.5? in 12? in 12.8? in .6? in .65? in .70?

2. There are how many hundredths in 4? in 4.2? in .3? in .16? in 1.25? in .325?

3. There are how many thousandths in 6? in 6.2? in .75? in 1.05? in .225? in .05?

4. There are how many ones in 30 tenths? in 45 tenths? in 500 hundredths? in 750 hundredths? in 9000 thousandths?

5. Give the number of tenths, hundredths, and thousandths in each of the following:

a. 4
b. 1.9
c. .3
d. 10.5
e. .75
f. .05
g. 7
h. 7.7
i. .08
j. 3.2

CHANGING A COMMON FRACTION TO A DECIMAL

1. Change the fraction $\frac{5}{8}$ to a decimal.

$$\frac{5}{8} = \begin{array}{r} .625 \\ 8\overline{)5.000} \\ \underline{4\,8} \\ 20 \\ \underline{16} \\ 40 \\ \underline{40} \end{array}$$

$$\frac{5}{8} = .625$$

In 5 there are 50 tenths, 500 hundredths, and 5000 thousandths. Since neither the tenths nor the hundredths can be divided evenly by 8, the 5 is changed to 5000 thousandths which can be divided evenly by 8.

2. Change the following to decimals: *a.* $\frac{3}{4}$; *b.* $\frac{1}{8}$; *c.* $\frac{1}{4}$; *d.* $\frac{5}{16}$; *e.* $\frac{6}{25}$; *f.* $\frac{4}{5}$; *g.* $\frac{7}{8}$; *h.* $\frac{9}{20}$; *i.* $\frac{17}{25}$; *j.* $\frac{3}{20}$.

3. Change $\frac{1}{3}$ to a three-place decimal. Can the exact decimal value be found for $\frac{1}{3}$? for $\frac{1}{6}$? for $\frac{5}{12}$? for $\frac{9}{16}$?

DIAGNOSTIC TEST IN DIVISION OF DECIMALS

Copy and divide the following:

	a	*b*	*c*		*a*	*b*	*c*
I.	$4\overline{)7.2}$	$3\overline{)5.7}$	$7\overline{)8.4}$	V.	$.3\overline{)7.2}$	$.6\overline{).48}$	$.7\overline{)4.55}$
II.	$2\overline{).12}$	$3\overline{).18}$	$6\overline{).54}$	VI.	$25\overline{).05}$	$36\overline{).018}$	$12\overline{).03}$
III.	$.6\overline{)18}$	$.4\overline{)6}$	$.3\overline{)45}$	VII.	$2\overline{)1}$	$25\overline{)12}$	$8\overline{)3}$
IV.	$.05\overline{)18}$	$.15\overline{)75}$	$.24\overline{)96}$	VIII.	$1.7\overline{).391}$	$.24\overline{).768}$	$1.2\overline{)3.756}$

If you missed more than one example in any group, review the study helps in division of decimals (pages 22–23). After you understand these study helps, turn to pages 307–308 for practice exercises keyed to this test.

*TOPICS FOR SPECIAL REPORTS

1. Write a brief history of the development of the metric system.

2. What is the purpose of the Weights and Measures Service of the Department of Trade and Commerce?

3. Our number system is called the "Hindu-Arabic System." Show why it is called by this name.

4. The chief characteristic of our number system is **place value.** What does place value mean? Illustrate it. Show that the Roman system of number does or does not have place value.

5. Bring one or more news items to class which require some mathematics in order to understand them. State what mathematics is necessary to understand each item.

ROUNDING OFF LARGE NUMBERS

Jack saw the following news item in his morning paper, "Dominion Government spends $5,322,253,505." He remembered that large numbers are sufficiently accurate for most purposes (and certainly easier to recall), if **rounded off.** So he expressed the amount, correct to the nearest million, as $5,322,000,000. That is, he replaced some of the actual figures by zeros, mere **place holders** in the number which he rounded off.

1. Study the following examples which show how numbers may be rounded off to the nearest thousand:

a. 5295 is rounded off to 5000 because the first figure dropped (2) is less than 5.

b. 6540 is rounded off to 7000 because the first figure dropped is 5.

c. 13,682 is rounded off to 14,000 because the first figure dropped (6) is greater than 5.

From these three examples make up a rule to use in rounding off numbers.

2. How many figures are replaced by zero when a number is rounded off to the nearest hundred? to the nearest ten thousand?

3. Round off the expenditures of the Dominion Government, as given in the news item, to the nearest hundred million; to the nearest hundred thousand.

4. Round off the following to the nearest thousand: *a*. 7499; *b*. 9500; *c*. 19,600; *d*. 850; *e*. 16,600.

5. Round off the following to the nearest hundred: *a*. 450; *b*. 649; *c*. 7960; *d*. 3849; *e*. 1880.

*6. On the books of the Government at Ottawa were the actual figures for expenditures entered or were the numbers rounded off? Explain.

ROUNDING OFF A QUOTIENT

1. On a trip of 325 miles, Mr. Scott's motor truck used 21 gallons of gasoline. Find the average mileage a gallon.

```
    15.476
21)325.000
   21
   115
   105
    100
     84
     160
     147
      130
      126
        4
```

The exact mileage a gallon cannot be found as a decimal. But accuracy to the nearest tenth of a mile is close enough for all practical purposes.

2. What was the number of miles a gallon to the nearest tenth of a mile? to the nearest hundredth of a mile?

The statements, "Express to the nearest tenth," or "to the nearest hundredth," may be written, "Express to the nearest 0.1," or "to the nearest 0.01."

3. The following examples show that decimals may be rounded off in the same manner as whole numbers.

.473 to nearest 0.01 is .47. Why? .587 to nearest 0.01 is .59. Why? 3.95 to nearest 0.1 is 4.0. Why?

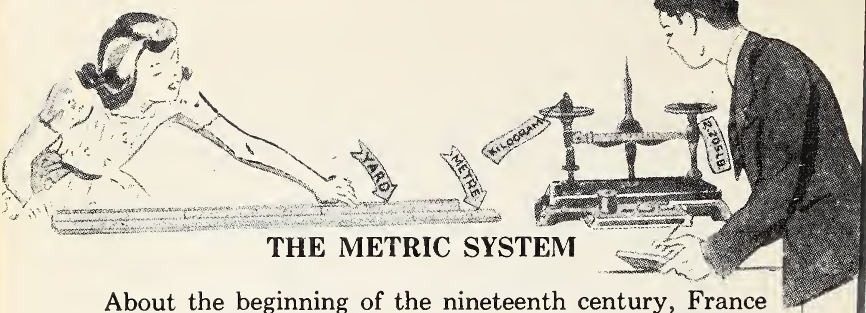
From these three examples make up a rule to use in rounding off a decimal.

4. Round off the following to the nearest 0.1: *a.* .46; *b.* .449; *c.* .95; *d.* 1.96; *e.* .329; *f.* .005.

5. Round off the following to the nearest 0.01: *a.* .536; *b.* .374; *c.* .095; *d.* 1.956; *e.* 9.995; *f.* .2449.

6. Express to the nearest 0.1 and then to the nearest 0.01: *a.* $\frac{1}{3}$; *b.* $\frac{2}{3}$; *c.* $\frac{5}{16}$; *d.* $\frac{7}{8}$; *e.* $\frac{3}{7}$; *f.* $\frac{5}{12}$.

7. A ballplayer's batting average is found by dividing the number of hits made by the number of times at bat. If a player was at bat 97 times and made 34 hits, find his batting average to the nearest 0.001.



THE METRIC SYSTEM

About the beginning of the nineteenth century, France adopted a system of measures based on 10. Each higher unit is ten times the next smaller unit. The standard for this system of measurement is the **metre** (measure), the length of which is about one ten-millionth of the distance from the Equator to the North Pole. This system of measures is called the "Metric System."

Our system of measurement is called the "English System." The units of length of the two systems are shown in the following table:

12 in.	=	1 foot
3 ft.	=	1 yard
5½ yd.	=	1 rod
320 rd.	=	1 mile

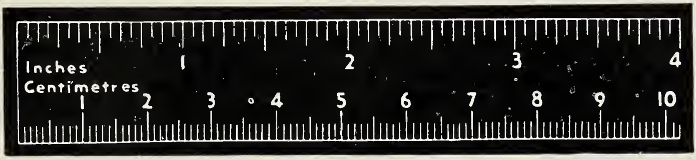
10 millimetres (mm.)	=	1 centimetre (cm.)
10 centimetres	=	1 decimetre
10 decimetres	=	1 metre (m.)
10 metres	=	1 decametre
10 decametres	=	1 hectometre
10 hectometres	=	1 kilometre (km.)

Note from the metric table that each succeeding unit is multiplied by 10 to find the next measure. This is not true for the English system of measures. The relation between a foot and the next higher unit is not 10, but 3, for the yard is three times the length of the foot. In other words, our system of measuring distances is not a **decimal** (based on 10) system.

1. Find the number of inches in a rod; in a mile.
2. Find the number of millimetres in a metre; the number of millimetres in a kilometre.
3. Which of the two problems did you find more difficult?

FAMILIAR UNITS IN THE METRIC SYSTEM

The **metre** is equivalent to 39.37 inches; that is, the metre is almost one tenth longer than the **yard.** From the table (page 28) you see that there are 100 centimetres in a metre. The length of a centimetre and of an inch are as shown.



Some metric measures are used so infrequently in this country that we need not study them. The most important measures of length are the centimetre, the metre, and the kilometre. The approximate values of these measures in our system are given in the following table:

1 centimetre = .4 in.
1 metre = 3.3 ft.
1 kilometre = .6 mi.

1. Professor Piccard of Belgium reached a height of 16,201 metres in his ascent into the stratosphere. How many kilometres did he ascend?

2. Captain Settle of the U. S. Navy reached a height of 61,217 feet. To the nearest hundredth, how many miles did he ascend?

3. Change 3.4 kilometres to metres; to centimetres.

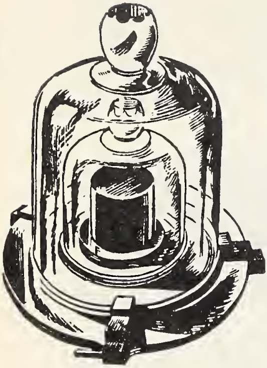
4. Change 468 centimetres to metres; to kilometres.

5. Change $2\frac{1}{4}$ miles to feet; to inches.

6. Change 23,760 feet to miles.

★7. Which is longer, the 100-yard dash or the 100-metre dash? How much longer?

METRIC SYSTEM OF WEIGHT



The unit of weight in the metric system is the **gram.** The most widely used metric measure of weight is the **kilogram.** The picture shows the kilogram which is in the custody of the National Research Council at Ottawa.

Part of the metric table for weights follows:

10 grams (g) = 1 decagram (dg)
10 decagrams = 1 hectogram (hg)
10 hectograms = 1 kilogram (kg)

1. How many grams are there in a kilogram?

2. A kilogram is about 2.2046 pounds. Which of the following is approximately equal to a gram?

a. .22 lb.; *b.* .022 lb.; *c.* .0022 lb.; *d.* .00022 lb.

3. The Standard kilogram kept by the National Research Council weighs 1000.00105 grams. How much does it vary from a perfect standard?

4. Part of the English system of measures of weight is as follows:

16 ounces (oz.) = 1 pound (lb.)
100 pounds = 1 hundredweight (cwt.)

Is there uniformity in the steps in the English measures of weight as there is in the metric system? Explain.

★5. The English system of measures has been described as a **collection** of measures and the metric system as a **system** of measures. What is meant by this statement?

THE PRAIRIE PROVINCES AND CANADA

1. Which are the Prairie Provinces?

2. How many symbols are used to represent each of the nine items shown on the graph? Each whole symbol represents what per cent of the total?

3. The land area of the Prairie Provinces is about 20% of the total land area of Canada. What per cent of the land area of Canada lies outside the Prairie Provinces?

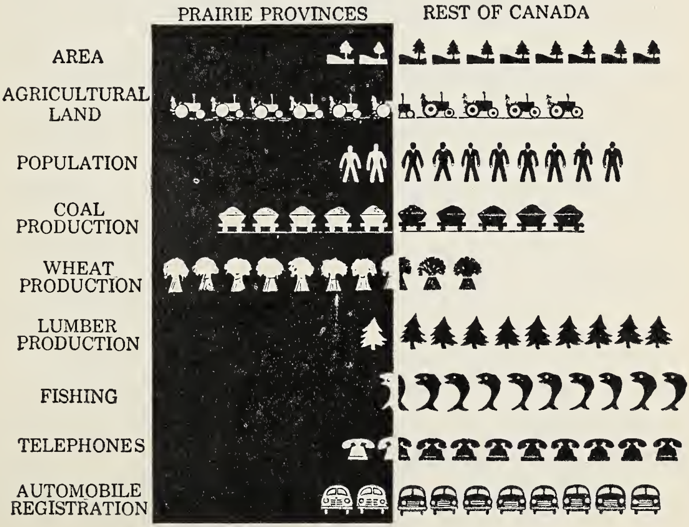
4. About what per cent of Canada's agricultural land lies in the Prairie Provinces?

5. The Prairie Provinces produce at least 50% of how many of the commodities shown?

*6. *a.* About what per cent of Canada's population lives in the Prairie Provinces?

b. According to population, the Prairie Provinces should use about what per cent of the telephones and automobiles in Canada?

c. Is this the case?



HOW WELL DO YOU REMEMBER?

1. There are how many hundreds, tens, and ones in each of the following:

a. 74,300? *b.* 600,000? *c.* 1,000,000? *d.* 148,000?

2. There are how many thousands in a million?

3. There are how many thousandths in .006? in .05?

4. Arrange the following decimals in order of size, beginning with the smallest: .5; .04; .1; .009; .06.

5. Moving the decimal point one place to the right is the same as multiplying by (?); moving it two places to the right is the same as multiplying by (?).

6. What is the smallest number each of the following numbers must be multiplied by to make it a whole number: *a.* 3.14? *b.* .765? *c.* 1.43? *d.* .075? *e.* 3.255?

7. What is the smallest common denominator for fractions having denominators: *a.* of 2, 6, and 8? *b.* of 3, 6, 8, and 12?

8. Write decimal fractions which have the same value as the following common fractions: *a.* $\frac{1}{4}$; *b.* $\frac{1}{8}$; *c.* $\frac{2}{5}$; *d.* $\frac{5}{8}$; *e.* $\frac{3}{4}$; *f.* $\frac{3}{5}$; *g.* $\frac{5}{16}$.

9. Express the following to the nearest tenth: *a.* 6.34; *b.* 4.09; *c.* 8.95; *d.* 0.99; *e.* 7.04.

10. Express the following to the nearest thousand: *a.* 46,300; *b.* 53,500; *c.* 97,499; *d.* 99,900.

11. Name three units for measuring distance in the English system; in the metric system.

12. Which is longer, a yard or a metre? an inch or a centimetre?

13. A plane averages 310 kilometres an hour. What is its rate in metres?

14. About 90 per cent of the automobiles stolen are recovered. About what per cent are not recovered?

THINGS TO REMEMBER

1. *How to add, subtract, multiply, and divide with whole numbers, fractions, and decimals.*

2. *How to round off numbers.*

3. *The meaning of the metric system and some of its most widely used units of measurement.*

4. *How mathematics helps you to understand some of the things which you read in the news.*

TEST ON CHAPTER I

1. A news headline stated that the Dominion Government had just appropriated more than four billion dollars. What mathematical term was used in this headline?

2. How many millions are there in four billion? Write four billion with figures.

3. Multiply 806 by 704 and check the result by two different methods.

4. When multiplication is used to check an example in division in which there is a remainder, how is the remainder used in the check? Divide 9367 by 18 and check the solution by multiplication.

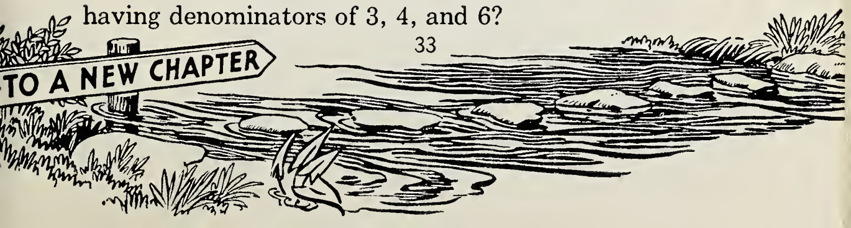
5. Round off the following to the nearest hundredth: *a*. 6.382; *b*. 0.076; *c*. 0.095; *d*. 2.004; *e*. 0.395.

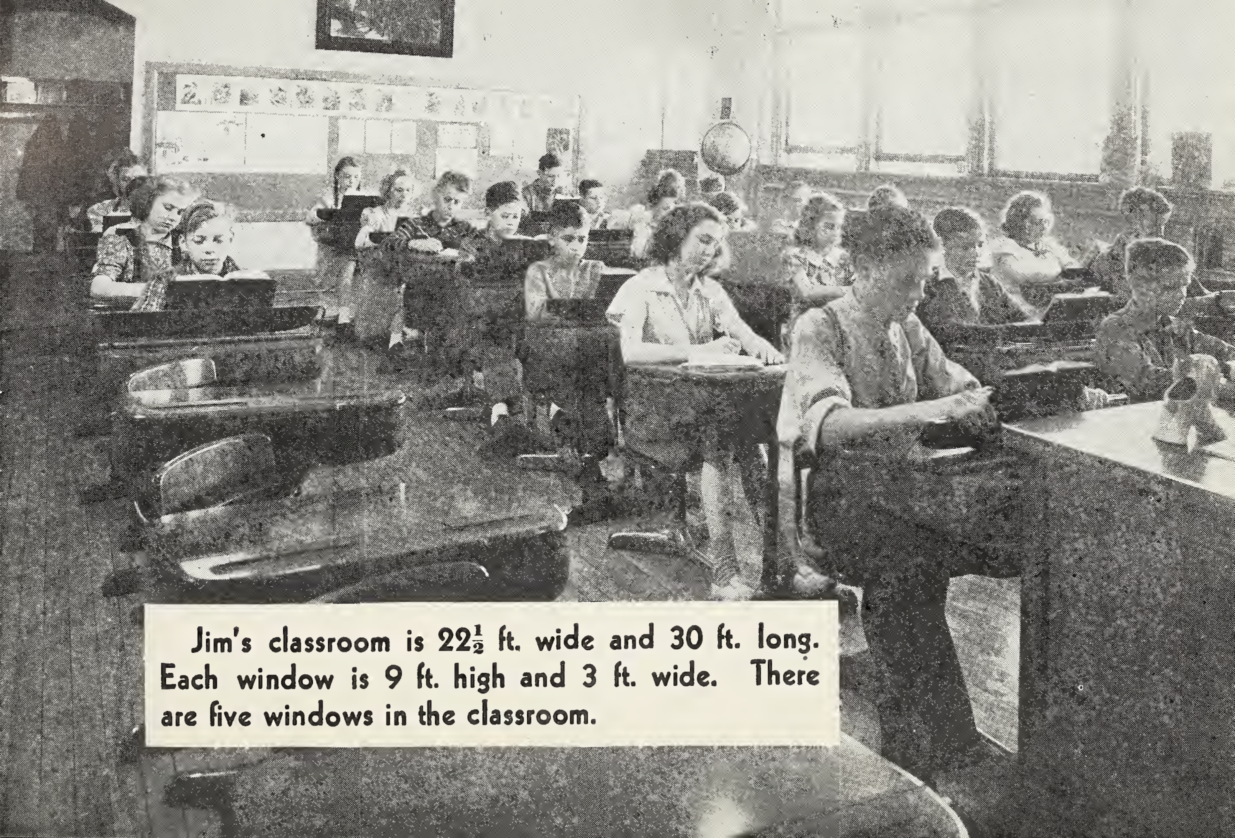
6. How do you change feet to miles? Change 18,480 feet to miles.

7. How do you change metres to kilometres? Change 18,480 metres to kilometres.

8. A kilometre is equal to about $\frac{5}{8}$ of a mile. If an airplane has a speed of 360 kilometres an hour, what is its speed in miles an hour?

9. What is the lowest common denominator for fractions having denominators of 3, 4, and 6?

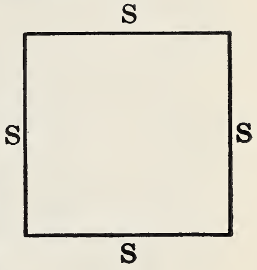




Jim's classroom is $22\frac{1}{2}$ ft. wide and 30 ft. long. Each window is 9 ft. high and 3 ft. wide. There are five windows in the classroom.

CHAPTER II

MORE ABOUT THE FORMULA



1. What kind of geometric figure is this?

2. How long is each of its sides?

3. What is the distance around the square?

4. How did you find this distance (problem 3)? What do you call this distance?

5. Write the rule for finding the perimeter of a square.

6. Write the **formula** for finding the perimeter of a square.

7. In the formula what did you use in place of numbers?

A formula, as you remember, **is simply a short way of expressing a rule by using letters in place of numbers or words.**

8. If the distance to a camp is 60 miles and you drive there in 2 hours, what is your speed an hour?

RULE: **Speed is distance divided by time.**

FORMULA: $S = \frac{D}{T}$

Tell what each letter in the formula means.

9. Find the perimeter of a square having a side of: *a.* 6 in.; *b.* 2 ft.; *c.* $5\frac{1}{4}$ ft.; *d.* 7.4 yd.; *e.* 18 cm.

10. If the side of one square is $6\frac{1}{2}$ feet and the side of another square is $5\frac{3}{4}$ feet, what is the difference in their perimeters?

*11. Write formulas to represent 4 rules in arithmetic that you have learned.

SIGHT SAVING

One day a lecturer came to Jim's school. The lecturer talked about "Sight Saving." "The windows of a classroom," said the lecturer, "should not be less than one fifth the floor area." Jim remembered that statement.

1. Page 34 is a picture of Jim's classroom. *a.* How wide is the room? How long? *b.* How wide is each window? How high?

2. What kind of geometric figure is the floor of Jim's classroom? Each window?

3. What is the area of the floor of Jim's classroom? Of each window?

4. How did you find the area of the floor? Of the window?

5. Find the area of each of the following rectangles (**Hint:** $A = lw$). What does "l" mean? "w"?

	l	w		l	w
a.	4 in.	3 in.	*d.*	4 mi.	3 mi.
b.	4 ft.	3 ft.	*e.*	4 cm.	3 cm.
c.	4 yd.	3 yd.	*f.*	4 km.	3 km.

6. Write the rule for finding the area of a rectangle.

7. Write the formula for finding the area of a rectangle.

8. What is the difference, if any, between lw and $l \times w$?

9. In finding the area of a rectangle, length and width must be expressed by the same unit of length (**linear unit**). What is the unit of length in problem 5*a*? 5*b*? 5*c*? 5*d*?

10. Why can you not find the area of the following rectangle by using the dimensions as given? $l = 4$ ft., $w = 3$ yd.

***11.** Jim's classroom has 5 windows. How much more than one fifth the floor area is the window area?

THE AREA OF RECTANGLES

Find the area of rectangles whose dimensions are:

	Length	Width		Length	Width
1.	15 in.	9 in.	8.	21 ft.	16 ft.
2.	27 ft.	18 ft.	9.	14 yd.	8 yd.
3.	8 mi.	3 mi.	10.	$6\frac{1}{2}$ ft.	4 ft.
4.	18 in.	$9\frac{7}{8}$ in.	11.	$4\frac{2}{3}$ yd.	$2\frac{1}{2}$ yd.
5.	$1\frac{1}{4}$ mi.	$\frac{3}{4}$ mi.	12.	25.5 in.	16.4 in.
6.	7.8 ft.	3.6 ft.	13.	47.2 ft.	12.5 ft.
7.	46 cm.	28 cm.	14.	76 cm.	38 cm.

15. A window has 8 panes, 18 inches by 14 inches. What is the area of each pane? of the window? (The space between each pane need not be considered.)

16. The dimensions of two rugs are $9' \times 12'$ (9 ft. by 12 ft.) and $8\frac{1}{2}' \times 11\frac{1}{2}'$. Find the difference in their areas.

17. The floor of a living room is $13' \times 20'$. If a rug, $12' \times 16\frac{1}{2}'$ is on the floor, how much of the floor is not covered?

18. The floor area for basketball is not uniform. The official playing court of greatest area is 94 feet long and 50 feet wide; the official playing court of smallest area is 60 feet long and 35 feet wide. How much greater is the area of one playing court than the other?

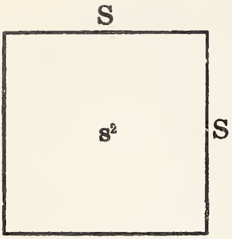
★19. If the length of a rectangle is doubled, but its width remains unchanged, how does that affect its area?

★20. If the width of a rectangle is doubled, but its length remains unchanged, how does that affect its area?

★21. If the length of a rectangle is doubled, and its width is halved, how does that affect its area?

★22. The area of the windows of a classroom should be at least $\frac{1}{5}$ of the floor area. Does Jim's classroom (p. 34) meet this requirement? Does your own?

THE AREA OF A SQUARE



1. Choose the correct answer, "Yes" or "No":

a. Are the sides of this figure of equal length?

b. Are the corners square?

c. Is the figure a square?

d. Is it a rectangle?

e. Are all squares rectangles?

f. Are all rectangles squares?

2. *a.* Write the formula for the area of a rectangle.

b. Are "*l*" and "*w*" of equal length in a square, or different?

c. Change the formula for the area of a rectangle to a formula for the area of a square, side "*l*"; side "*w*."

3. *a.* How are the sides of the square on this page labelled? the area?

b. Read this formula: $s \times s = s^2$.

c. What is the value of s^2 if $s = 2$? 4? 6? 8? 10?

Find the areas of squares having sides:

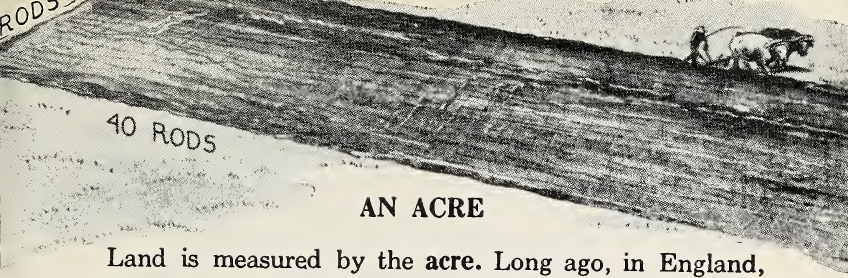
4. 8 in.
5. $3\frac{1}{2}$ yd.
6. 12 ft.
7. 1 mi.
8. $6\frac{1}{4}$ ft.
9. 20 cm.
10. 4.6 ft.
11. 4.5 m.

12. Find the perimeters in examples 6, 7, 8, and 9.

13. A square has a side of 3 inches and another square has a side twice as long. What is the perimeter of each figure? the area of each?

*14. If the side of a square is doubled, how does that affect its perimeter? its area?

*15. Clifford said, "Doubling the side of a square has the same effect on its area as doubling both the length and width of a rectangle." Prove that he was correct.

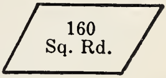


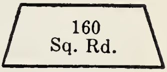
AN ACRE

Land is measured by the **acre.** Long ago, in England, an acre was simply the amount of land two oxen, yoked together, could plough in a day.

1. What is the shape of the ploughed strip? How long? How wide? Its area? Is the ploughed land an acre, more, or less?

2. Here are two geometric forms. Name them. What is the area of each form? May an acre be any shape? Explain.



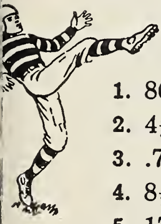


3. *a.* How many feet are in a rod?

b. How many square feet are in an acre?

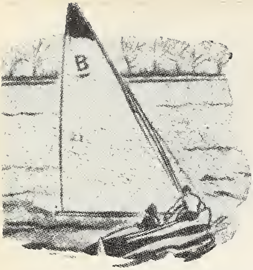
★4. Prove that there are 640 acres in a square mile.

★5. What is a **section** of land?



LET'S PRACTISE

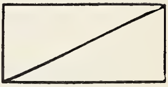
1. $864 + 509 + 476 + 592 + 870 + 359 = ?$
2. $4\frac{3}{8} + 5\frac{1}{4} + 12\frac{1}{2} + 9\frac{3}{4} + 1\frac{7}{8} = ?$
3. $.74 + .38 + .09 + .98 + .50 + .86 = ?$
4. $8\frac{1}{2} - 5\frac{3}{4} = ?$
5. $17\overline{)9182}$
6. $4.2 \times 36 = ?$
7. $\frac{5}{6} \div 2\frac{1}{2} = ?$
8. $.06 \times 5.94 = ?$
9. $3\frac{1}{4} \times 6\frac{1}{2} = ?$
10. $501 - 105 = ?$
11. $14\overline{)19.6}$
12. $9\frac{1}{4} - 3\frac{5}{6} = ?$
13. $72 \div \frac{4}{9} = ?$
14. $1\frac{1}{2} \div 2 = ?$
15. $1\frac{1}{8} \times \frac{8}{9} = ?$
16. $80.10 - 4.16 = ?$
17. $.28\overline{)476}$
18. $1.9 \times .037 = ?$



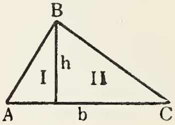
HARRY'S SAILBOAT

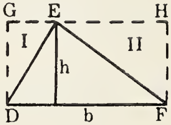
Harry had a sailboat. He knew, in general, that the bigger the sail the more speed the boat. So he had a natural interest in the size of his sail. What shape is the sail? How do you find its area?

A rectangle, Harry knew, can be divided by its diagonal into two equal right triangles. "But," asked Harry, "is **any triangle,** which has the same base and height as a rectangle, equal to half of the rectangle?"



Harry drew the triangle *ABC* with a base *b* and an altitude *h*. Then he drew another triangle *DEF*, equal to the triangle *ABC*. He cut the first triangle into two parts along the altitude *h*. He took Part I of the triangle *ABC* and placed it in the position of the triangle, *DGE*; Part II, and placed it in the position of the triangle, *FEH*. What kind of a figure did he form?





1. What is the base of the figure *DFHG*? the height?

2. What is the base of the triangle *DEF*? the altitude?

3. What is the area of the rectangle *DFHG*? of the triangle *DEF*?

4. State the rule which Harry must use to find the area of his sail (HINT: Half the product of base and altitude).

5. Express this rule as a formula.

6. If Harry's sail is 10 feet wide at the base and 20 feet high, what is its area?

AREAS OF TRIANGLES

Find the area of triangles the dimensions of which are as follows:

	BASE	ALTITUDE		BASE	ALTITUDE
1.	12 in.	8 in.	7.	14 ft.	9 ft.
2.	8 in.	6 in.	8.	26 cm.	14 cm.
3.	14 yd.	5 yd.	9.	$8\frac{1}{4}$ in.	6 in.
4.	18 ft.	$7\frac{1}{2}$ ft.	10.	7 ft.	9.2 ft.
5.	12.4 ft.	8 ft.	11.	1.5 mi.	1.8 mi.
6.	1 mi.	$\frac{1}{2}$ mi.	12.	$\frac{1}{2}$ ft.	2 ft.

13. If a triangular sail is 16 feet wide at the base and 9 feet high, what is its area?

*14. If two triangles have equal bases but different altitudes, which has the greater area?

*15. If two triangles have equal altitudes but different bases, which has the greater area?

*16. Draw figures to represent the triangles in problems 14 and 15.

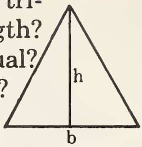
*17. By substituting numbers for letters in the formula $A = \frac{1}{2} bh$, show that the following statements are true: *a*. the area is equal to the product of the base and half of the altitude; *b*. the area is equal to the product of the altitude and half of the base.

*18. If the base of a triangle is doubled but its altitude remains the same, what effect does this have on its area?

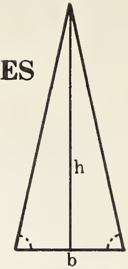
*19. If the altitude of a triangle is doubled but its base remains the same, what effect does this have on its area?

*20. If both the base and the altitude of a triangle are doubled, what effect does this have on its area?

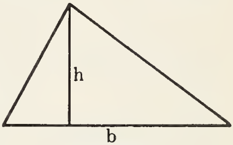
KINDS OF TRIANGLES AS TO SIDES



Equilateral



Isosceles



Scalene

1. Here are 3 triangles. Which triangle has all sides of equal length? All sides unequal? Only two sides equal?

2. What is an **equilateral** triangle?

3. What is a **scalene** triangle?

4. What is an **isosceles** triangle?

5. What is the altitude of each triangle shown? its base? its area?

6. An equilateral triangle, as you see, is also **equiangular** (all angles the same size). How many degrees in each of these angles? (Hint: There are 180° in the sum of the angles of a triangle.)

7. If the side of an equilateral triangle is s, make a formula for the perimeter of the triangle.

8. Using the formula (problem 7), find the perimeter when $s = 4$ inches; when $s = 6\frac{1}{2}$ feet.

9. The base of an isosceles triangle is 5 inches and one of the equal sides is 8 inches. What is the perimeter?

10. The base of an isosceles triangle is b and one of the equal sides is s. Make a formula for the perimeter.

11. The sides of a scalene triangle are a, b, and c. Make a formula for the perimeter.

12. Using the formula (problem 11), find the perimeter when $a = 9$, $b = 10\frac{1}{2}$, and $c = 13\frac{3}{4}$.

*13. If an isosceles triangle contains a right angle, it is called an **isosceles right triangle.** Draw this kind of a triangle.

*14. Find the perimeter of the triangle which you have drawn.

*15. Find its area.

KINDS OF TRIANGLES AS TO ANGLES

1. Here are some questions to answer and things to do:

a. How many degrees in a right angle? Draw a right angle.

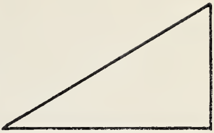
b. Is an acute angle more or less than a right angle? Draw an acute angle.

c. Is an obtuse angle more or less than a right angle? Draw an obtuse angle.

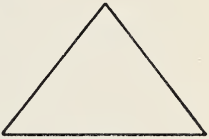
d. How many right angles in a straight angle? Draw a straight angle.

2. Which of the triangles contains a **right angle**? This form is a **right triangle** because it contains an angle of 90°.

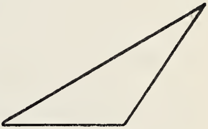
3. Which triangle contains 3 **acute** angles? This form is an **acute triangle** because it contains 3 angles each less than 90°.



Right



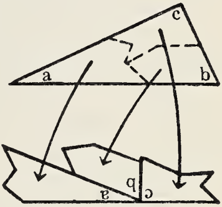
Acute



Obtuse

4. Which triangle contains an **obtuse** angle? This form is an **obtuse triangle** because it contains an angle greater than 90° but less than 180°.

5. Draw any triangle, and label the angles. Cut angle *a* from the triangle and place it as shown. Do the same with angles *b* and *c*. Angles *a*, *b*, *c* together form what kind of an angle? Equal how many degrees?



6. The sum of the angles in any triangle equal how many degrees? Prove your answer by drawing, labeling, and cutting several triangles.

7. The number of degrees in the angles of a triangle is equal to how many right angles?

MORE ABOUT PARALLELOGRAMS

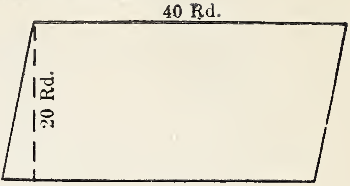


Fig. A

1. The field (Fig. A) is how long? How far across?

2. Find two parallel sides of this field; two other parallel sides. What kind of geometric form is Figure A? What is its altitude?

3. Tell why Figure A is or is not a rectangle.

Last school year you learned one way of finding the area of a parallelogram. Doris uses another method.

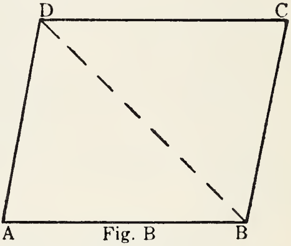


Fig. B

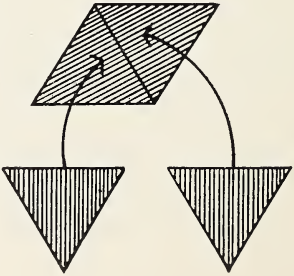
She drew the parallelogram *ABCD*, and the diagonal *BD*. She cut along the diagonal *BD* and formed two triangles *ABD* and *BCD*. By placing one triangle upon the other she found that they were equal.

Doris said, "The area of the parallelogram must be twice the area of each triangle." Why was she correct?

She wrote the formula for the area of a triangle: $A = \frac{1}{2}bh$. Then she doubled this to get the formula for the area of her parallelogram. You write this formula.

4. Cut a parallelogram along its diagonal. Place one triangle upon the other. Are they equal?

5. Cut from paper two equal triangles and place them opposite each other as shown. What geometric form did you make?



6. From your experiments prove that the area of a parallelogram is equal to the product of the base and the altitude.

7. Change this rule to a formula for the area of a parallelogram.

Find the area of parallelograms whose dimensions are:

	BASE	ALTITUDE		BASE	ALTITUDE
8.	9 in.	6 in.	**11.**	$6\frac{1}{2}$ ft.	14 ft.
9.	$15\frac{1}{2}$ ft.	$4\frac{1}{2}$ ft.	**12.**	$4\frac{2}{3}$ yd.	$9\frac{1}{3}$ yd.
10.	16.7 ft.	12.5 ft.	**13.**	14.6 cm.	9.5 cm.

14. Find the area of the field (Fig. 44-A).

***15.** Find illustrations around your home or school of parallelograms which are not rectangles.

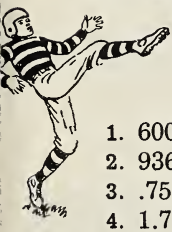
***16.** Show by a drawing that a parallelogram may have all sides equal and not be a square.

***17.** If the base of a parallelogram is doubled and the altitude is unchanged, what change is made in the area?

***18.** If the altitude of a parallelogram is doubled and the base is unchanged, what change is made in the area?

***19.** If both the base and the altitude of a parallelogram are doubled, what change is made in the area?

***20.** Draw two parallelograms which are equal in area but have different bases and altitudes.

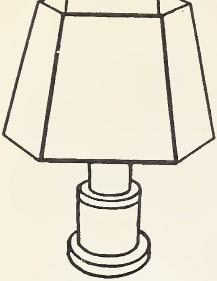


LET'S PRACTISE

	a	*b*	*c*
1.	$60060-18076=?$	$9\frac{1}{4}-8\frac{5}{6}=?$	$6\frac{1}{4}\times4\frac{2}{5}=?$
2.	$9366\div18=?$	$54\div\frac{6}{7}=?$	$5\frac{1}{6}\div3\frac{1}{3}=?$
3.	$.752-.748=?$	$.09\times3.6=?$	$3.7\times9.4=?$
4.	$1.728\div1.2=?$	$.6\div.03=?$	$58.32\div32.4=?$

5. $763+908+1456+72+5360+427=?$

6. $3\frac{3}{4}+2\frac{7}{8}+9\frac{1}{2}+6\frac{2}{3}+2\frac{3}{8}=?$



THE TRAPEZOID

1. How many sides has each face of the lamp shade in Jack's study? How many of these sides are parallel? not parallel?

2. What do you call a 4-sided figure that has only two sides parallel?

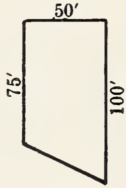


Fig. A

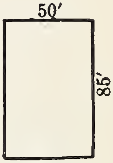


Fig. B

Jack's house is built on a lot shaped like the trapezoid (Fig. A). Harry's house is built on a rectangular lot (Fig. B). Harry said that his lot is the larger, but he could not prove his statement. Jack showed him how to find the area of a trapezoid.

"Cut out two trapezoids of equal size," said Jack. "One of the parallel sides of a trapezoid is known as its upper base and the other as its lower base." How are these bases marked in Figure A?

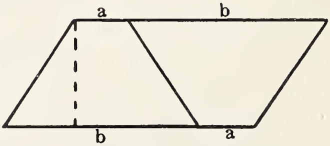


Fig. C

"Place the two trapezoids in the position shown (Fig. C). What kind of a figure is formed by the two trapezoids? The base of this figure is $a + b$, or the sum of the upper base and the lower base of either trapezoid.

"How does the altitude of each trapezoid compare with the altitude of the parallelogram?

"The area of the parallelogram is how many times as much as the area of each trapezoid?

"From this work," continued Jack, "we can make a rule and a formula for the area of a trapezoid."

RULE: **The area of a trapezoid is equal to one half the product of the altitude and the sum of the bases.**

FORMULA: $A = \frac{1}{2}h\ (a + b)$. The signs ( ) are **parentheses.** They indicate that *a* is to be added to *b* before multiplying by *h*.

What does each letter represent in the formula?

Find the area of the following trapezoids:

ALTITUDE	UPPER BASE	LOWER BASE	ALTITUDE	UPPER BASE	LOWER BASE
1. 8 ft.	7 ft.	12 ft.	**4.** $4\frac{1}{2}$ ft.	5 ft.	9 ft.
2. 3 mi.	2 mi.	5 mi.	**5.** $5\frac{1}{2}$ yd.	7 yd.	10 yd.
3. 4.6 ft.	6.3 ft.	9.8 ft.	**6.** 1.5 ft.	3.5 ft.	8.0 ft.

7. Which lot was the larger, Jack's or Harry's (page 46)? How much larger?

***8.** If the altitude of a trapezoid is doubled but the other dimensions remain unchanged, how has the area been changed?

***9.** Show by substituting numbers in the formula $A = \frac{1}{2}h\ (a + b)$ that either of the following rules may be used to find the area of a trapezoid:

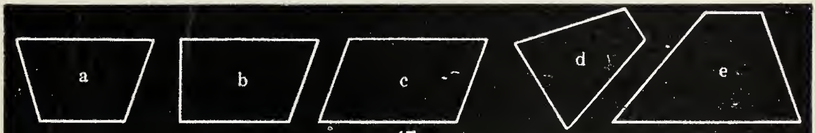
a. RULE: **The area of a trapezoid is equal to one half of the altitude multiplied by the sum of the bases.**

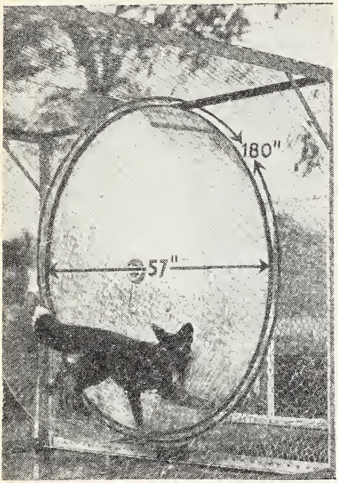
b. RULE: **The area of a trapezoid is equal to one half of the sum of the bases multiplied by the altitude.**

***10.** Which rule would be the easier to use in finding the area of trapezoids whose dimensions are:

a. $h = 8, a = 7, b = 12$ *b.* $h = 9, a = 6, b = 10$

11. Which of the following figures are trapezoids?





THE FOX WHEEL

Jim's father has a fox farm. The foxes are given exercise by putting them on a fox wheel with a treadway.

1. Jim measured the diameter of the fox wheel. How long is this diameter in inches? in feet?

2. Jim measured the circumference of the fox wheel. How long is the circumference in inches? in feet?

3. Jim divided the circumference by the diameter. His quotient was $3\frac{1}{7}$. Check Jim's answer.

4. Then Jim remembered the rule which he had learned for finding the circumference of a circle. Copy this rule and insert the missing number.

RULE: **The circumference of a circle is about** (?) **times as long as its diameter.**

5. Change this rule (problem 4) to a formula by using C for circumference and d for diameter.

6. The ratio of the circumference of a circle to its diameter is about 3.14; $3\frac{1}{7}$; or $\frac{22}{7}$. This ratio, as you recall, is spelled **PI**, pronounced **PIE,** and written π. Write the formula for finding the circumference of a circle (problem 5) but use π in place of $3\frac{1}{7}$.

7. If $d = 8$, what is r? If $r = 5\frac{1}{2}$, what is d?

8. As $d = 2r$, the formula for the circumference of a circle may also be written $C = 2\pi r$. Write this formula as a rule.

RADIUS, DIAMETER, CIRCUMFERENCE

1. A circular fountain is 10 feet in diameter. What is the distance around the fountain?

> The distance around the fountain is its **circumference.**
>
> **$d = 10$; $C = ?$; $C = \pi d$ $C = \frac{22}{7} \times 10 = \frac{220}{7}$ or $31\frac{3}{7}$**

2. Solve problem 1 by using the formula $C = 2\pi r$. Show that the result will be the same.

Find the missing values: (Use $\pi = \frac{22}{7}$)

3.

	a	*b*	*c*	*d*	*e*
d =	21 in.	9 ft.	5 yd.	4 rd.	1 mi.
C =	?	?	?	?	?

4.

r =	8 in.	$3\frac{1}{2}$ ft.	1.5 mi.	36 cm.	8 m.
C =	?	?	?	?	?

5. The diameter of an automobile wheel is 28 inches. How far will the car move in one revolution of the wheel?

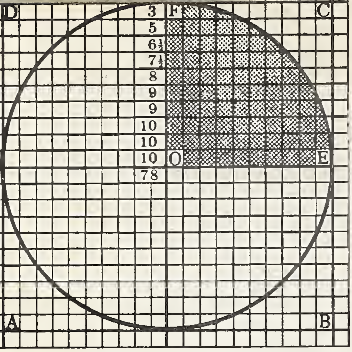
6. How many revolutions, to the nearest whole number, will the wheel of the car (problem 5) make in going a mile? (5280 ft. = 1 mi.)

7. Show that a circular running track, having a diameter of 140 yards, will have a circumference of a quarter of a mile (440 yards).

*8. If the diameter of a circle is **doubled**, what effect has that on the circumference? on the **radius**?

*9. If the radius of a circle is doubled, what effect has that on the circumference? on the diameter?

*10. If the circumference of one circle is twice as large as the circumference of another circle, show that the diameter of the one circle will be twice as large as the diameter of the other circle.



AREA OF A CIRCLE

David read in his arithmetic book that a circle having the same diameter as a square is .78 of the area of the square. He also read that the area of a circle may be found by the formula $A = \pi r^2$. He wondered whether or not these statements were correct so:

a. He drew on graph paper a square, *ABCD*, with a side of 20 units.

b. Within this square he drew a circle with a diameter of 20 units, radius 10 units.

c. In the formula $A = \pi r^2$, David substituted 3.14 for π, 10 for r, and found the area to be $3.14 \times 100 = 314$.

d. He used radius *OE* as the side of a square and found the area of *OECF* to be $10 \times 10 = 100$.

e. He shaded the part of the circle contained within the square *OECF*.

f. He counted all the shaded squares and all squares half or more shaded. How many was this?

g. David said, "There are 100 small squares in one fourth the square *ABCD*. There are 78 shaded squares (all or more than half shaded) in one fourth of the circle. Therefore the area of the circle is $\frac{78}{100}$, or .78, or 78% of the area of the square *ABCD*."

If David counted 78 squares in one fourth of a circle, how many squares are in the circle? How many squares would he have found by using the formula $A = \pi r^2$? These answers differ by 2 squares. Why?

From this work David proved that his rule and formula for finding the area of a circle are correct.

RULE: **The area of a circle is equal to π times the square of the radius.**

FORMULA: $A = \pi r^2$. (r^2 means $r \times r$, read "*r-square.*")

1. A circular pond is 8 feet in diameter. Find its area.

$$d = 8 \qquad r = 4 \qquad A = \pi r^2$$
$$A = \frac{22}{7} \times 4 \times 4 = \frac{352}{7} = 50\tfrac{2}{7}$$

Find the area of a circle having a radius of: ($\pi = \frac{22}{7}$)

2. 3 ft.	4. 1 in.	6. 25 in.	8. 14 ft.
3. 9 yd.	5. 24 cm.	7. 2 mi.	9. $3\frac{1}{2}$ yd.

10. From a fire tower on top of a mountain, a forest ranger can see 21 miles in every direction on a clear day. What is the number of square miles over which he can keep watch?

11. If a circular skating rink is 100 feet in diameter, how much skating surface does it have?

*12. Two circles which have the same centre are called **concentric circles.** If two concentric circles have radii of 12 feet and 8 feet respectively, find the areas of the two circles. Find the difference in the areas of these two circles.

*13. Decide which of the following statements are **true** and which are **false.**

a. If two circles have equal diameters, their areas are equal.

b. If two circles have equal circumferences, their areas are equal.

c. If the radius of a circle is 1, the area is about 1.

d. If the radius of a circle is doubled, the circumference is doubled.

e. If the radius of a circle is doubled, the area is doubled.

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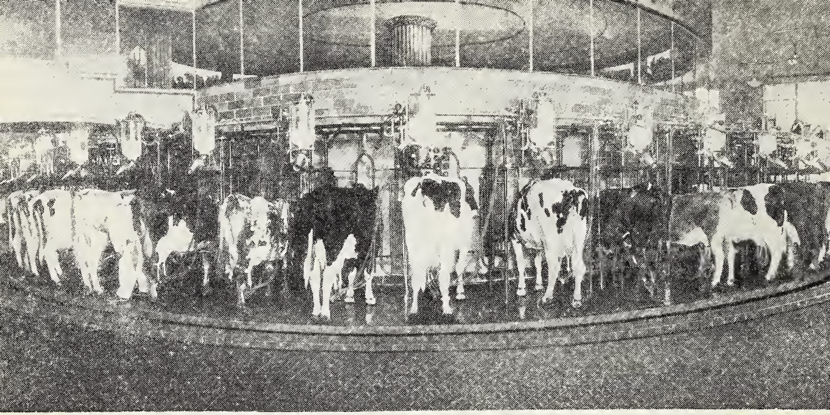


THE ROTOLACTOR

The rotolactor has places for 50 cows on its platform. A cow steps on, rides around once, is milked, and steps off, all in $12\frac{1}{2}$ minutes.

1. If the diameter of the rotating platform is 60 feet, what is its circumference? (Use $\pi = 3.14$)

2. If the rotolactor makes one revolution in $12\frac{1}{2}$ minutes, how far does a point on the circumference move in 1 minute? (Give answer to nearest tenth of a foot.)

3. If 50 cows can be milked in $12\frac{1}{2}$ minutes, at that rate how many can be milked in one hour?

4. How long does it take to milk the 1680 cows in the herd at the dairy?

5. Eight cows an hour is a good record for milking by hand. At that rate, how many men would be required to milk 1680 cows in 6 hours?

*6. How does the use of milking machines affect the number of people employed?

*7. Do you think the price of milk would be more, or less, a quart than it now is if milking machines were not used?

A GIANT EYE

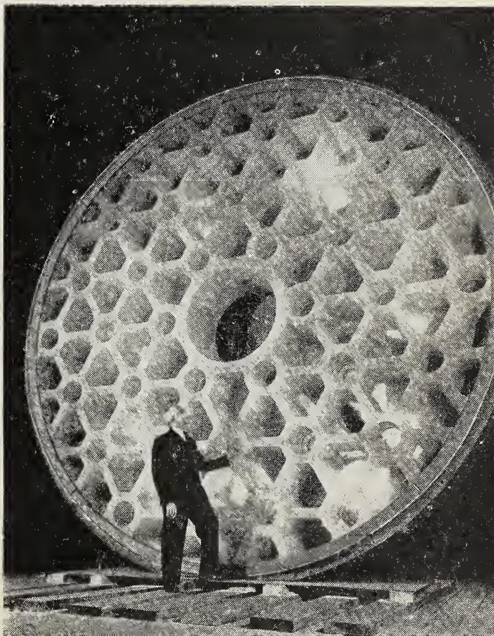
The largest telescope in the world, on Palomar Mountain, California, has a lens 200 inches in diameter. The second largest telescope, also in California, on Mt. Wilson near Pasadena, has a lens 100 inches in diameter.

1. What is the diameter in feet of the lens of the Mt. Wilson telescope? of the lens of the telescope on Palomar Mountain?

2. The 100-inch lens has 160,000 times the light-gathering capacity of the human eye. The 200-inch lens has 640,000 times the light-gathering capacity of the human eye. The larger lens is how many times as powerful as the smaller?

*3. State why the larger telescope should have about four times as much light-gathering power as the smaller. (HINT: Consider the areas.)

*4. Light from stars 1,200,000,000 **light years** distant can be seen with the 200-inch lens. A **light year,** as you recall, is the distance light travels in a year at the rate of about 186,000 miles a second. Is a light year more or less than 6 trillion miles? (1 yr. = 365$\frac{1}{4}$ da.)



HOW WELL DO YOU REMEMBER?

1. What is the difference between the perimeter of a figure and its area?

2. If a square has a side of 1 inch, what is its perimeter? its area?

3. If a circle has a radius of 1 foot, what is its circumference? its area? (Use $\pi = 3.14$)

4. Find the area of rectangles whose dimensions are as follows: *a.* length, 6 in.; width, 4 in.; *b.* length, 16 ft.; width, 9 ft.; *c.* length, 42 cm.; width, 29 cm.

5. Find the perimeters of squares whose sides are: *a.* 9 in.; *b.* $2\frac{1}{2}$ in.; *c.* 18 ft.; *d.* 3.5 yd.

6. Find the area of each square given in problem 5.

7. What is an equilateral triangle? an isosceles triangle? a scalene triangle? Draw an example of each of these triangles.

8. If the side of an equilateral triangle is s, write a formula for its perimeter. Find p when $s = 18$.

9. Draw a right triangle; an obtuse triangle; an acute triangle which is not equilateral.

10. Find the area of triangles when: *a.* $b = 9$ in. and $h = 14$ in.; *b.* $b = 7$ ft. and $h = 9$ ft.

11. Find the area of parallelograms when: *a.* $b = 7$ yd. and $h = 5$ yd.; *b.* $b = \frac{1}{8}$ mi. and $h = \frac{1}{4}$ mi.

12. Find the area of trapezoids when: *a.* $h = 6$ in., $a = 5$ in., and $b = 8$ in.; *b.* $h = 9$ ft., $a = 7$ ft., and $b = 10$ ft.

13. All rectangles are parallelograms, but all parallelograms are not rectangles. Why?

14. If a diagonal of a rectangle is drawn, what kind of triangles are formed?

THINGS TO REMEMBER

1. *To use formulas for areas and perimeters of most plane figures having three or four sides.*

2. *To use formulas for the circumference and the area of a circle.*

3. *How to substitute numbers for letters in a formula.*

TEST ON CHAPTER II

1. If the side of a square is 9 inches, what is its perimeter? its area?

2. A rectangle is 40 feet wide and 75 feet long. What is its area?

3. Find A in the formula $A = \frac{1}{2}h(a + b)$, when $h = 4$, $a = 7$, and $b = 10$.

4. Find A in the formula, $A = \frac{1}{2}bh$, when $b = 24$ and $h = 15$.

5. Find C in the formula, $C = 2\pi r$, when $r = 3\frac{1}{2}$. ($\pi = \frac{22}{7}$)

6. Find A in the formula, $A = \pi r^2$, when $r = 7$. ($\pi = \frac{22}{7}$)

7. If the height of a step is s, what will be the height of 5 of these steps?

8. What is the difference between an isosceles triangle and an equilateral triangle? Draw one of each kind.

9. What is the difference between an obtuse triangle and a right triangle? Draw one of each kind.

10. What is the difference between a rectangle and a parallelogram? between a parallelogram and a trapezoid?

11. If the side of an equilateral triangle is s, show that its perimeter is $3s$. Using the formula $p = 3s$, find p when $s = 4\frac{1}{2}$ inches.

12. Write the formula for the area of: *a*. a parallelogram; *b*. a triangle; *c*. a trapezoid; *d*. a circle.

⋆TOPICS FOR SPECIAL REPORTS

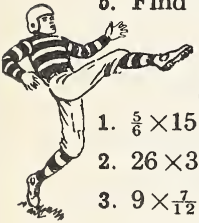
1. Show that a triangle is rigid but that a figure of four or more sides is not. Where are triangular figures used very frequently? Why?

2. Make a list of at least ten different things which are in the shape of a trapezoid, as for example, sides of waste-baskets.

3. Divide a circle into 8 equal parts. Arrange these parts so that they almost form a parallelogram. Since the base of the parallelogram is half of the circumference, show that the formula for the area of a circle may be found by substituting πr $(\frac{1}{2}C)$ in the formula for the area of a parallelogram.

4. Make a drawing for each of the following figures having four sides: *a.* quadrilateral; *b.* rectangle; *c.* rhombus; *d.* parallelogram.

5. Find the number of acres in your school grounds.

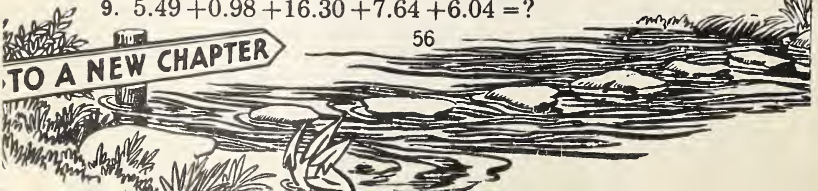


LET'S PRACTISE

	a	*b*	*c*
1.	$\frac{5}{6} \times 15 = ?$	$24 \div \frac{2}{3} = ?$	$9000 - 1706 = ?$
2.	$26 \times 3\frac{3}{4} = ?$	$306 \times 508 = ?$	$9\frac{1}{4} - 3\frac{7}{8} = ?$
3.	$9 \times \frac{7}{12} = ?$	$78.4 \div .28 = ?$	$8200 \div 328 = ?$
4.	$3.7 \times .068 = ?$	$14 - 4\frac{7}{8} = ?$	$2\frac{3}{8} \times 5\frac{1}{4} = ?$
5.	$1\frac{2}{3} - \frac{3}{4} = ?$	$.0912 \div 16 = ?$	$.25 \times .25 = ?$
6.	$1 \div \frac{7}{8} = ?$	$7\frac{1}{2} \times 3\frac{1}{3} = ?$	$806 \times 739 = ?$
7.	$.900 - .358 = ?$	$86 \times 4\frac{1}{2} = ?$	$.01 \div 2 = ?$

8. $7\frac{3}{8} + 16\frac{2}{3} + 5\frac{1}{4} + 9\frac{1}{2} + 14 + 12\frac{7}{8} = ?$

9. $5.49 + 0.98 + 16.30 + 7.64 + 6.04 = ?$



CHAPTER III

HERE'S WHERE THE MONEY GOES

"Here's Where the Money Goes" shows retail sales **per capita** (a person) in Canada.

1. What per cent represents the total sales per capita?

2. If about 23% of retail sales are made by food stores, what per cent remains for other retail merchants?

3. What per cent of retail sales are made by merchants other than auto dealers and gas stations?

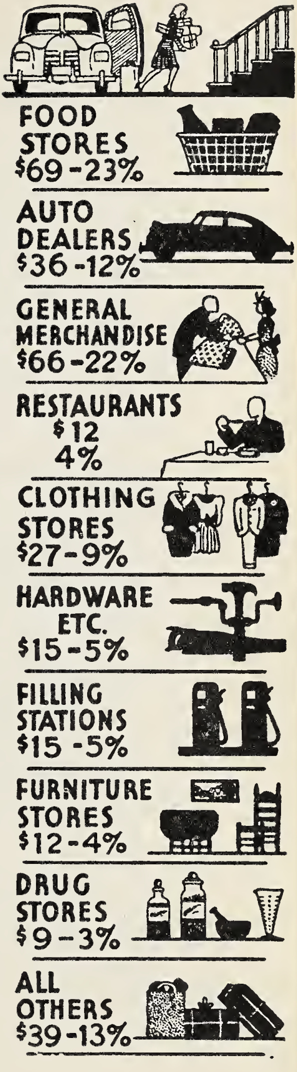
4. Add the per cents on the graph. Check your sum against the per cent in problem 1. Do they agree? Why?

5. What per cent less was spent for automobiles than for food? (HINT: Would you combine restaurants with food stores? filling stations with auto dealers?)

6. If the Davis family of 5 persons spends as in the graph, how much a year do their purchases cost?

7. How much does the Davis family spend in a year for food? for each of the other items in the chart?

*8. If your family bought as shown here, how much would it spend each year for each item? for all the items?



DIAGNOSTIC TESTS IN PERCENTAGE

I. Write the following per cents as decimals:

1. 5%
2. 40%
3. 15%
4. $1\frac{1}{2}\%$
5. 2.5%
6. 10%
7. 1.25%
8. 1%

II. Write the following decimals as per cents:

1. .25
2. .0225
3. .6
4. .405
5. .03
6. .1
7. .125
8. .025

III. Write the following per cents as fractions:

1. 25%
2. $33\frac{1}{3}\%$
3. 50%
4. $12\frac{1}{2}\%$
5. 10%
6. 80%
7. 75%
8. $16\frac{2}{3}\%$

IV. Write the following fractions as per cents:

1. $\frac{3}{4}$
2. $\frac{1}{6}$
3. $\frac{1}{5}$
4. $\frac{1}{4}$
5. $\frac{1}{3}$
6. $\frac{3}{5}$
7. $\frac{1}{2}$
8. $\frac{2}{3}$

V. Find the missing numbers in the following:

1. 10% of 50 = ?
2. 15% of 75 = ?
3. 4% of 45 = ?
4. 1% of 80 = ?
5. 45% of 16 = ?
6. 2% of 250 = ?
7. 25% of 60 = ?
8. 30% of 120 = ?
9. 20% of 15 = ?
10. 100% of 24 = ?
11. 50% of 5 = ?
12. $1\frac{1}{2}\%$ of 60 = ?

VI. Find the missing per cents in the following:

1. 3 = ? % of 6
2. 4 = ? % of 40
3. 6 = ? % of 8
4. 15 = ? % of 15
5. 60 = ? % of 360
6. 3 = ? % of 200
7. 15 = ? % of 60
8. 7 = ? % of 21
9. 9 = ? % of 100
10. 32 = ? % of 80
11. 120 = ? % of 600
12. 2.5 = ? % of 100

If you missed any of the examples in the test, you will find similar examples for practice on pages 59–61, 65–66. The test is keyed to the practice work. Section I in the test, to illustrate, has the same kind of examples as Section I on page 59.

PRACTICE IN PER CENTS—I—II

Per cent, as you have learned, means **hundredths.** In the 4 examples shown below, per cents have been changed to decimals. Read each example, then work it on paper.

12% = .12
3% = .03
40% = .40 = .4
$2\frac{1}{2}\%$ = 2.5% = .025

a. In working each example, tell what was done with the per cent sign; the decimal point.

b. Write the rule for changing a per cent to a decimal.

I. Write as decimals:

1. 16%
2. 4%
3. 80%
4. 3.5%
5. 30%
6. 4.25%
7. $1\frac{1}{2}\%$
8. $5\frac{1}{4}\%$
9. $12\frac{1}{2}\%$
10. 6.7%
11. 1%
12. 10%
13. $2\frac{1}{4}\%$
14. $3\frac{3}{4}\%$
15. 5.2%
16. 1.45%

In the 6 examples shown below, decimals have been changed to per cents. Read each example, then work it on paper.

.15 = 15%
.6 = .60 = 60%
.04 = 4%
.125 = 12.5%
.015 = 1.5%
.005 = .5%

a. In working each example, the per cent sign was moved how many places? toward the left or right?

b. Write the rule for changing a decimal to a per cent.

II. Write as per cents:

1. .14
2. .65
3. .1
4. .875
5. .01
6. .025
7. .8
8. .6
9. .05
10. .375
11. .6667
12. $.33\frac{1}{3}$
13. .134
14. .023
15. .9
16. .09
17. .0325
18. .445
19. .105
20. $.66\frac{2}{3}$

PRACTICE IN PER CENTS—III

Any number which is written as a per cent may be written also as a fraction.

Express 25% as a fraction.

$$25\% = \frac{25}{100} = \frac{1}{4}$$

a. In working the example what sign was dropped?

b. The per cent was written as a fraction having what denominator?

c. How was the fraction reduced to lowest terms?

d. Write the rule for changing a per cent to a fraction.

III. Write the following per cents as fractions:

1. 10%
2. 15%
3. 50%
4. 40%
5. 75%
6. 5%
7. 30%
8. 45%
9. 4%
10. 12%

Express $16\frac{2}{3}\%$ as a fraction.

$$16\tfrac{2}{3}\% = \frac{16\frac{2}{3}}{100}$$

$$\frac{3 \times 16\frac{2}{3}}{3 \times 100} = \frac{50}{300}$$

$$16\tfrac{2}{3}\% = \frac{50}{300} = \frac{1}{6}$$

$$16\tfrac{2}{3}\% = \frac{1}{6}$$

Multiply both numerator and denominator by 3, the denominator of the given fraction.

Explain each step in the work.

Express as fractions:

11. $12\frac{1}{2}\%$
12. $62\frac{1}{2}\%$
13. $33\frac{1}{3}\%$
14. $87\frac{1}{2}\%$
15. $66\frac{2}{3}\%$
16. $37\frac{1}{2}\%$
17. $83\frac{1}{3}\%$
18. $2\frac{1}{2}\%$

*19. $6\frac{1}{4}\%$

*20. $18\frac{3}{4}\%$

*21. $56\frac{1}{4}\%$

*22. $6\frac{2}{3}\%$

PRACTICE IN PER CENTS—IV

Edith was given $\frac{1}{4}$ of the money she received from the sale of Christmas cards. What per cent did she receive?

$\frac{1}{4} = .25 = 25\%$ Edith received 25% of the sales price.

Express $\frac{3}{8}$ as a per cent.

$$\begin{array}{r} .375 \\ 8\overline{)3.000} \\ \underline{2\,4} \\ 60 \\ \underline{56} \\ 40 \\ \underline{40} \end{array}$$

You know that
$.375 = 37.5\%$.
So $\frac{3}{8} = 37.5\%$
or $\frac{3}{8} = 37\frac{1}{2}\%$

Express $\frac{5}{6}$ as a per cent.

$$\begin{array}{r} .83\frac{1}{3} \\ 6\overline{)5.00} \\ \underline{4\,8} \\ 20 \\ \underline{18} \\ 2 \end{array}$$

You know that
$.83\frac{1}{3} = 83\frac{1}{3}\%$.
So $\frac{5}{6} = 83\frac{1}{3}\%$

To change a fraction to a per cent, divide the numerator by the denominator, carry the result to two decimal places, and then express the quotient as a per cent.

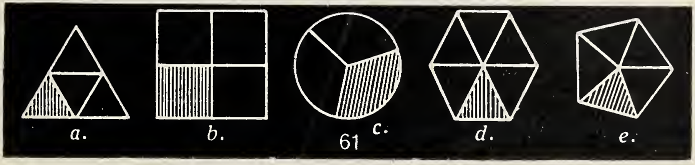
IV. Change the following fractions to per cents:

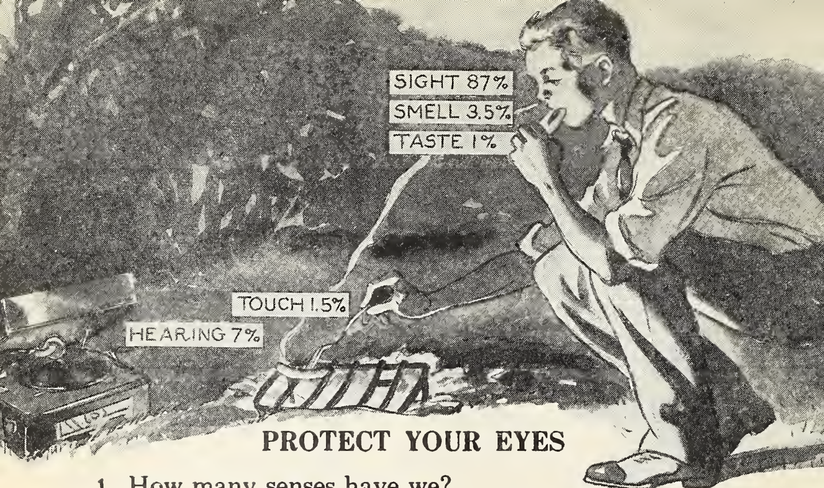
1. $\frac{1}{2}$
2. $\frac{5}{8}$
3. $\frac{5}{16}$
4. $\frac{1}{7}$
5. $\frac{2}{5}$
6. $\frac{7}{8}$
7. $\frac{1}{16}$
8. $\frac{5}{7}$
9. $\frac{3}{5}$
10. $\frac{9}{16}$
11. $\frac{5}{9}$
12. $\frac{7}{12}$
13. $\frac{4}{15}$
14. $\frac{9}{14}$
15. $\frac{15}{16}$

Memorize the per cent value of each of the following fractions. They are used frequently.

$\frac{1}{2} = 50\%$ $\frac{2}{3} = 66\frac{2}{3}\%$ $\frac{3}{4} = 75\%$ $\frac{2}{5} = 40\%$
$\frac{1}{3} = 33\frac{1}{3}\%$ $\frac{1}{4} = 25\%$ $\frac{1}{5} = 20\%$ $\frac{3}{5} = 60\%$

16. What per cent of each figure is shaded?





PROTECT YOUR EYES

1. How many senses have we?

2. They are "serving men" who tell us about our world and the people in it. Which sense is most helpful to us? List the other senses in order of helpfulness.

3. The sense of sound is how many times as valuable as the sense of smell? of touch? of taste?

4. The sense of sight is about how many times as valuable as the sense of sound? of smell? of touch?

5. We depend on sight more than upon all the other senses. How much more?

6. Two serving men, our eyes, tell us what per cent of all we know? What per cent do we learn through our other senses? Work this problem by use of the picture. Then work it without the picture. (HINT: What per cent represents **all** that we learn from our senses?)

*7. How does the graph show that we must protect our sight above all other senses? What are some ways of protecting the eyes?

*8. If a person were blind, which of the other senses probably would help him most?

CHECKING AIR IN TIRES

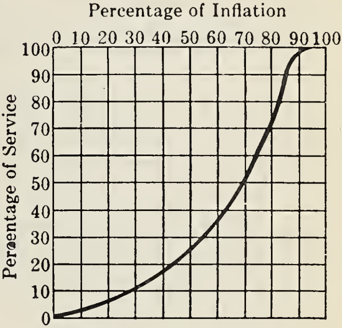
"See that automobile tire," said Ralph. "It is so soft that the side walls are cracking. The owner must keep it inflated (swelled with air) to a pressure recommended by the manufacturer, or the tire won't give good mileage." How much mileage may be lost by underinflation is shown in the graph.

1. How do you measure the amount of air in a tire?

2. If a tire is 80% inflated, about what per cent of the mileage in the tire will it yield?

3. If a tire is supposed to be inflated to 40 pounds but is inflated only to 30 pounds, how will its mileage be affected?

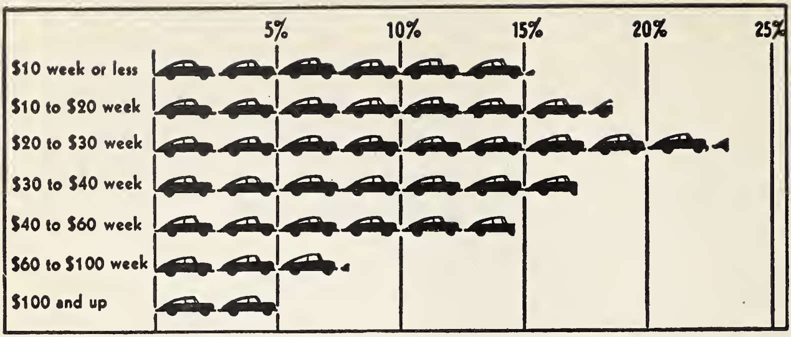
4. A manufacturer guaranteed his tire to run 20,000 miles if kept inflated to 35 pounds. If the tire is kept inflated to 28 pounds, what would be the expected mileage?



Effect of Underinflation

5. Another manufacturer guaranteed his tire for 20,000 miles if kept inflated to 30 pounds. Mr. Grayson bought one, inflated it to 15 pounds, and expected to get 10,000 miles. About how much mileage did he get?

★6. If a tire is inflated to 40 pounds, would the pressure be more, or less, after driving on a hot day? How does heat affect the amount of pressure in tires? the speed of the car?



INCOME OF AUTOMOBILE-OWNING FAMILIES

1. About what per cent of the families owning automobiles have an income of $10 or less a week?

2. If a family's income averages $10 a week, how much is that a year?

3. About what per cent of the families owning automobiles have an income of $100 or more a week?

4. If a family's income averages $100 a week, how much is that a year?

5. About what per cent of families owning automobiles have weekly incomes from $10 to $20? from $20 to $30? from $30 to $40? from $40 to $60? from $60 to $100?

6. One family drives its car 5000 miles a year and averages 20 miles to a gallon of gasoline at 35¢ a gallon. Find the yearly cost of the gasoline.

*7. A family has a weekly income of $20. How much money would it have after paying for the gasoline in problem 6? Can a family in this income group afford to drive a car 5000 miles a year? Explain.

*8. How much do you think the family income should be in order to afford a car?

PRACTICE IN PER CENTS—V

1. Mr. Martin bought a house for $3250, paying 25% in cash. How much was the cash payment?

Method I

$25\% = .25$

$$\begin{array}{r} \$3250 \\ \underline{\times .25} \\ 16250 \\ \underline{6500} \\ \$812.50 \end{array}$$

Method II

$25\% = \frac{1}{4}$

$\frac{1}{4} \times \$3250 = \$812.50$

The cash payment was $812.50. Which method is easier?

a. In Method I how was the per cent changed? in Method II?

b. In Method I by what was the cost of the house multiplied? in Method II?

c. Write the rule for finding the per cent of a number.

2. You are to find 46% of a number. Will you express 46% as a decimal or as a common fraction? Why?

V. Find the missing number in each of the following examples. (Solve examples 3–12 without use of pencil.)

3. 10% of 50 = ?
4. 1% of 80 = ?
5. 5% of 200 = ?
6. 100% of 16 = ?
7. 25% of 100 = ?
8. 6% of 60 = ?
9. 20% of 50 = ?
10. 4% of 300 = ?
11. $33\frac{1}{3}\%$ of 75 = ?
12. 40% of 200 = ?
13. 24% of 65 = ?
14. $12\frac{1}{2}\%$ of 72 = ?
15. 15% of 125 = ?
16. 50% of 375 = ?
17. $2\frac{1}{2}\%$ of 450 = ?
18. 35% of 145 = ?
19. 9% of 765 = ?
20. 87.5% of 250 = ?
21. 37.5% of 620 = ?
22. 4.5% of 1450 = ?

23. A new automobile loses about 35% of its value the first year of use. If the car cost $1500 new, about how much is it worth at the end of its first year?

PRACTICE IN PER CENTS—VI

1. In a class of 36 pupils, there were 24 boys. What per cent of the class was boys?

The number of boys was $\frac{24}{36}$ of the number of pupils.

$$\frac{24}{36} = \frac{2}{3} = 66\tfrac{2}{3}\%$$

2. A basketball team won 11 of its 15 games. What per cent of its games did it win?

$$\frac{11}{15} = \begin{array}{r} .73\frac{1}{3} \\ 15\overline{)11.00} \\ \underline{10\,5} \\ 50 \\ \underline{45} \\ 5 \end{array}$$

The number of games won was $\frac{11}{15}$ of the number played. Change $\frac{11}{15}$ to hundredths.

$$.73\tfrac{1}{3} = 73\tfrac{1}{3}\%$$

They won $73\frac{1}{3}\%$ of the games played.

To find what per cent one number is of another: **Write the numbers as a fraction. The number compared is the numerator and the number with which it is compared is the denominator. Then change the fraction to a per cent.**

VI. Find the missing number in each of the following examples. (Solve examples 3–12 without use of pencil.)

3. 4 = ? % of 8
4. 9 = ? % of 12
5. 2 = ? % of 10
6. 25 = ? % of 75
7. 1 = ? % of 20
8. 5 = ? of 100
9. 1 = ? % of 100
10. 50 = ? % of 200
11. 6 = ? % of 6
12. 5 = ? % of 50
13. 15 = ? % of 40
14. 35 = ? % of 90
15. 140 = ? % of 175
16. 160 = ? % of 600
17. 110 = ? % of 160
18. 210 = ? % of 450
19. 500 = ? % of 750
20. 120 = ? % of 720
21. 90 = ? % of 1000
22. 360 = ? % of 1440

EVERYDAY USES OF PERCENTAGE

1. If customers do not pay their store bills within six months, merchants know that only 67% of the amount due (on the average) will ever be paid. A merchant has $750 owing to him on which nothing has been paid for 6 months. How much will he probably be able to collect?

2. A tennis club has a membership of 68. If 75% of the members are boys, how many in the club are boys?

3. Eighteen of the 32 pupils in an eighth-grade class are girls. What per cent of the class is girls?

4. If a school basketball team played 16 games and won 11 of them, what per cent of the games did it win? What per cent did it lose?

5. A pair of shoes, regularly priced at $4.50, was sold at a sale for $3.75. What was the per cent reduction?

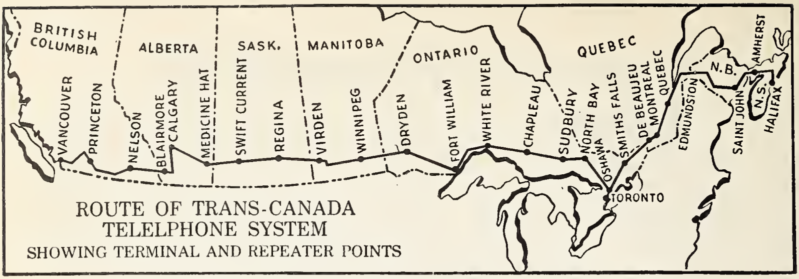
6. About 30 out of every 1000 young people in Canada graduate from university. What per cent of our young people graduate from university?

7. In a recent year about 205,000 Canadian children entered grade 1. About how many of these will likely graduate from university?

*8. Edward raised 8 tons of sugar beets which tested 13.6% of their weight in sugar. How many pounds of sugar can be made from the beets?

*9. Of 100 pupils, 75 are in elementary school, 21 in high school, and 4 in college. If 25% of our population of 11,500,000 is in school, how many are in each kind of school?

*10. The standard weight of a bushel of wheat is 60 pounds. A farmer found that the wheat grown on one of his fields averaged 7% more than the standard. What was the average weight of a bushel of this wheat?


BRITISH COLUMBIA
ALBERTA
SASK.
MANITOBA
ONTARIO
QUEBEC
N.B.
N.S.
VANCOUVER
PRINCETON
NELSON
BLAIRMORE
CALGARY
MEDICINE HAT
SWIFT CURRENT
REGINA
VIRDEN
WINNIPEG
DRYDEN
FORT WILLIAM
WHITE RIVER
CHAPLEAU
SUDBURY
NORTH BAY
OSHAWA
SMITHS FALLS
DE BEAUJEU
MONTREAL
QUEBEC
EDMUNDSTON
SAINT JOHN
AMHERST
HALIFAX
TORONTO

ROUTE OF TRANS-CANADA
TELEPHONE SYSTEM
SHOWING TERMINAL AND REPEATER POINTS

OUR CHANGING TELEPHONE RATES

On January 25th, 1932, the Trans-Canada Telephone Line was officially declared open. On that day the first trans-continental telephone call (Halifax to Vancouver) was made over an all-Canadian circuit.

1. In 1932 the day rate for a 3-minute station-to-station call between Edmonton and Halifax was $8.50. To-day it is $4.90. Find the per cent reduction.

2. Some other "old" and "new" telephone rates are shown in the following table. Find the per cent reduction in each case.

STATIONS	DAY RATE		PER CENT REDUCTION	NIGHT RATE		PER CENT REDUCTION
	Old	New		Old	New	
Edmonton to Montreal....	$6.75	$4.20		$4.00	$2.70	
Winnipeg to Edmonton...	$3.00	$2.50		$1.65	$1.45	
Edmonton to Saskatoon ...	$1.95	$1.80		$1.00	$ .90	
Vancouver to Edmonton..	$3.00	$2.70		$1.50	$1.30	
Regina to Edmonton ..	$2.55	$2.30		$1.30	$1.15	

3. Is the per cent reduction in day rates the same between any two stations?

4. Is the per cent reduction in night rates the same as for day rates or different?

*5. How would you account for the general reduction in rates since 1932?

EGGS 18¢ A DOZEN

PRICES ARE NOT FIXED

Mr. Brooks keeps a record of the price received for eggs from his poultry farm. He found that the average selling price of eggs is lowest in May and highest in December.

The per cent increase or decrease is always figured on the number from which the change is made.

1. If the average price of a dozen eggs is 18¢ in May and 54¢ in December, what is the increase in price? the per cent increase?

2. What is the decrease in price of a dozen eggs from 54¢ in December to 18¢ in May? the per cent decrease?

3. During November, the price of a dozen eggs increased from 32¢ to 40¢. What was the per cent increase?

4. During March, the price of a dozen eggs decreased from 40¢ to 32¢. What was the per cent decrease?

5. Study the results of problems **1-4**. Then answer the following questions:

a. Can the per cent increase be greater than 100%? Explain.

b. Must the per cent decrease always be less than 100%? Explain.

★*c.* If an article increases 25% in cost and then drops to the original price, what is the per cent decrease? How much more or less is this than 25%?

★**6.** What are some things which cause the price of eggs to increase? decrease?

PER CENTS TO THE NEAREST TENTH

1. A merchant found that for every \$19 of expense in running his business, \$10.20 was used to pay salaries. The salaries represented what per cent of the expenses?

$$\begin{array}{r@{}l} & .5368 \\ 19 & \overline{)10.2000} \\ & \underline{9\,5} \\ & 70 \\ & \underline{57} \\ & 130 \\ & \underline{114} \\ & 160 \\ & \underline{152} \\ & 8 \end{array}$$

.5368 = .537 to the nearest thousandth

.537 = 53.7% (to the nearest tenth per cent)

Salaries were 53.7% of the expenses.

a. The quotient was carried to how many decimal places?

b. What is the fourth-place figure? Is it 5 or more?

c. How was the third-place figure changed?

d. Tell how to find per cent to the nearest tenth.

2. A baseball team won 11 out of 14 games played. Find the per cent of games won, to the nearest tenth per cent.

3. The Grade eight class of the Brock School made a table which helped them to find quickly the per cent attendance to the nearest tenth per cent. There were 35 pupils enrolled, and the class record showed that there had never been fewer than 28 present. Copy and complete the following table and find the missing values, to the nearest tenth per cent.

Enrolled	35	35	35	35	35	35	35	35
Present	35	34	33	32	31	30	29	28
Per cent attendance	?	?	?	?	?	?	?	?

*4. Make a per-cent attendance table for your class.

PER CENTS GREATER THAN 100 PER CENT

1. What per cent of a quart of milk is a quart of milk?

2. What per cent of a pound of sugar is 2 pounds of sugar? 3 pounds? 4 pounds? 5 pounds?

3. Explain the meaning of the following:

a. The population of Millville is 250% of what it was 20 years ago.

b. Living costs are 200% of what they were 10 years ago.

4. Rewrite each of the following statements using per cents:

a. Harry earns twice as much as he did last year.

b. The population of Bay City is three times as great as it was 25 years ago.

5. Write the following as decimals or as whole numbers: *a.* 210%; *b.* 150%; *c.* 100%; *d.* 103%; *e.* 225%.

6. Write the following as per cents:
a. 1.25; *b.* 2; *c.* $2\frac{1}{2}$; *d.* 1; *e.* 1.4; *f.* 3.3.

7. Without pencil, find the missing numbers:

a. $6 is ? % of $2
b. $4 is ? % of $3
c. 16 qt. is ? % of 8 qt.
d. 30 in. is ? % of 12 in.
e. 12 ft. is ? % of 3 ft.
f. 50 mi. is ? % of 10 mi.
g. 5 bu. is ? % of 4 bu.
h. 12 in. is ? % of 1 ft.

8. If a merchant sells an article at twice the cost, his margin is equal to the cost. The margin is what per cent of the cost?

9. The population of a city increased from 10,000 to 25,000. What was the increase? the per cent increase?

★10. A baby weighed 8 pounds at birth, and 20 pounds on its first birthday. The increase in weight was how many times the weight at birth? What was the per cent increase?

PER CENTS LESS THAN 1%

"I will cash this cheque for you," said the bank teller to Mr. Brown, "but there will be a service charge because it is drawn against an out-of-town bank. The charge in this case is $\frac{1}{8}\%$ of the amount of the cheque."

1. Mr. Brown's cheque was drawn for $400. Find the service charge.

$\frac{1}{8}\% = \frac{1}{8}$ of 1%   1% of $400 = $4.00
Then, $\frac{1}{8}$ of $4.00, or $.50, will be the charge.

To find a fractional per cent of a number, find 1% of the number and multiply this amount by the given fraction.

Find the following:

	a	*b*	*c*
2.	$\frac{1}{2}\%$ of $1000	$\frac{1}{2}\%$ of $2500	$\frac{1}{4}\%$ of $4000
3.	$\frac{3}{4}\%$ of $12,000	$\frac{1}{8}\%$ of $20,000	$\frac{1}{2}\%$ of $900
4.	$\frac{1}{12}\%$ of $900,000	$\frac{1}{12}\%$ of $480,000	$\frac{1}{10}\%$ of $15,000
5.	$\frac{1}{5}\%$ of 10,000	$\frac{1}{8}\%$ of 100,000	$\frac{1}{2}\%$ of 3800

6. A collector is paid $\frac{1}{2}\%$ for collecting a bill of $450. How much does he receive as his fee?

7. A bank charges 0.1% to collect a bill of $1850. Find the cost of collection.

8. A certain kind of soap is advertised as $99\frac{44}{100}\%$ pure. What is its percentage of impurity?

9. When the birth rate of a nation exceeds the death rate by 6 out of 1000, what per cent is that?

*10. In a recent year there were 75 school teachers to every 10,000 population in Canada. Teachers represent what per cent of our population?

*11. How many teachers are there in Canada if the population is about 11,500,000?

*FINDING A NUMBER FROM ITS FRACTIONAL PART

1. In a city election, $\frac{3}{5}$ of the registered voters cast their ballots. If there were 7314 ballots cast, how many registered voters were in the city?

If $\frac{3}{5}$ of the registered voters is 7314, $\frac{1}{5}$ of the registered voters is $\frac{1}{3}$ of 7314, or 2438. $\frac{5}{5}$ of the registered voters is 5 × 2438, or 12,190.

Check: $\frac{3}{5} \times 12{,}190 = 7314$.

2. Jack said, "If $\frac{3}{5}$ of the registered voters is 7314, the number of those registered can be found by dividing 7314 by $\frac{3}{5}$." Prove that Jack's method also gives the correct answer.

Find the number when:

3. $\frac{2}{3}$ of it $= 72$

4. $\frac{3}{4}$ of it $= 96$

5. $\frac{3}{8}$ of it $= 51$

6. $\frac{5}{6}$ of it $= \$4.50$

7. $\frac{3}{4}$ of it $= \$7.80$

8. $\frac{2}{5}$ of it $= \$12.60$

9. $\frac{5}{8}$ of it $= 120$

10. $\frac{4}{9}$ of it $= 180$

11. $\frac{9}{10}$ of it $= 540$

12. $\frac{2}{3}$ of it $= 4\frac{1}{2}$

13. $\frac{1}{2}$ of it $= 11\frac{1}{4}$

14. $\frac{1}{8}$ of it $= 9\frac{5}{6}$

15. If a car travels 36 miles in $\frac{3}{4}$ of an hour, how far will it travel in one hour at the same rate?

16. A 9-ounce package of cheese sells for 18¢. At that rate, what is the price a pound?

17. A can of peaches, containing 14 fluid ounces, sold for 21¢. At that rate, what is the cost of a pint can of peaches? (20 fluid ounces = 1 pint.)

18. $7 \times ? = 42$

19. $28 \times ? = 375$

20. $.6 \times ? = 3.6$

21. $.05 \times ? = \$96$

22. $.75 \times ? = 30$

23. $.16 \times ? = 49.6$

24. $\frac{3}{4}$ of ? $= 75$

25. .75 of ? $= 15$

26. .06 of ? $= 4.26$

27. If you know the product of two numbers and one of the numbers, how do you find the other number?

*FINDING THE WHOLE FROM A PER CENT

Percentage is used to find:

a. The per cent of a number

b. What per cent one number is of another

c. A number when a per cent of it is given.

The first and second uses you know. The third is explained in this lesson.

1. The Boys' Athletic Association bought a basketball at $9.60. This was 80% of the regular price of the ball. What was the regular price?

Method I

Think: 80% of ? = $9.60
80% = .80
.80 of the regular price = $9.60
or .80 of ? = $9.60
Then, $9.60 ÷ .80 = the regular price
$9.60 ÷ .80 = $12
Check: .80 × $12 = $9.60.

Method II

80% of ? = $9.60
If 80% of the cost = $9.60
1% of the cost = $.12
100% of the cost = $12.00
Check: .80 × $12 = $9.60

To find a number when a per cent of it is given, change the per cent to a decimal and divide the number by this decimal.

Make up a rule for Method II.

Find the missing values in the following:

2. 30 = 10% of ?
3. 5 = 5% of ?
4. 100 = 20% of ?
5. 24 = 12% of ?
6. 16 = 4% of ?
7. 20 is 5% of ?
8. $6 is 3% of ?
9. $8 is 4% of ?
10. 2% of ? is 10
11. 15% of ? is 45

*EVERYDAY USES OF PERCENTAGE

1. A boy earned $8 by selling subscriptions to magazines. If he received 40% of the price of the magazines for his work, how much money did he take in?

2. A man wishes to have at retirement, age 65, a yearly income of $1200 from money invested at 4%. How much money must he invest to provide that income?

3. In a college football game, the home team received 60% of the gate receipts. If the home team's share was $21,600, what were the total receipts?

4. "50% alcohol is enough anti-freeze protection for your car," said the gas-station attendant to Mr. Long. "Put in 75% and be safe," replied Long. If the attendant poured 12 quarts of alcohol into the radiator, what was the capacity of the radiator?

5. A newspaper headline stated that 192 of the members of the House of Commons voted for a certain bill. This was 80% of the members present. How many members were present?

6. Mr. Jones was offered a subscription to a magazine for $3 a year. This was only 60% of the regular price. What was the regular price?

7. A newspaper headline stated that 30% of the people who graduated from a local high school in June went to college. If 36 members of the class went to college, what was the total number of graduates?

***8.** In a recent year 6,075 automobile accidents occurred on Sundays. This represented 16.2% of the total number of automobile accidents for that year. How many occurred during the entire year?

***9.** At a rate of $\frac{1}{2}$%, the charge for collecting a bill was $3.20. What was the amount of the bill?

COST OF OPERATING AN AUTOMOBILE

Mr. Bailey read in his daily paper that the cost of operating an automobile is about $6\frac{1}{2}$¢ a mile. The various items which make up this cost were also given.

	Cents a Mile	Per Cent of Total Cost
a. Gasoline	1.75	26.92
b. Oil	0.28	?
c. Tires and tubes	0.64	?
d. Maintenance	1.72	?
e. Depreciation	1.39	?
f. License and insurance	0.36	?
g. Interest	0.36	?
Total	?	?

1. Find the total cost of operating the car.

2. Find the per cent (to the nearest tenth) each item was of the total cost.

3. What do these items in the table mean:

a. Maintenance? *b.* Depreciation? *c.* License and insurance? *d.* Interest?

4. No charge was included for garage rental. If that item were included, how would it affect the cost a mile? the per cent of the total cost for each item?

5. If the average motorist drives about 5000 miles a year, what is the yearly cost of operating his car (see problem 1)?

6. How much could Mr. Average Motorist (problem 5) save a year by using a bus at an average cost of 2.2¢ a mile?

7. If Mr. Average Motorist had a family of 5 people to transport, would it be cheaper for his family to travel by bus or by private car? How much cheaper a mile?

8. The average life of an automobile is 7 years. If a new car costs $1600 and is traded in every year, how much must the owner pay at each trade (see table)?

IF TRADE-IN IS MADE	1ST YR. INITIAL COST	2ND YR. COST	3RD YR. COST	4TH YR. COST	5TH YR. COST	6TH YR. COST	7TH YR. COST
Every year	$1600	$400	$400	$400	$400	$400	$400
Every 2 yr.	$1600		$720		$720		$720
Every 3 yr.	$1600			$1020			$1020

9. If car is traded every 2 years, what does owner pay at each trade? if traded every 3 years? every 7 years?

10. Find the total cost (of operation and trade-in) to the car owner for a yearly trade; for a trade every 2 years; every 3 years.

*11. Find the average yearly cost for each kind of trade-in. Decide if it is cheaper to trade in a car every year, every second year, or every third year.

*MORE THAN ENOUGH

1. The principal of the City Park School said that his enrolment was 750, or 20% more than the building was planned to accommodate. How many pupils was the building planned to accommodate?

Since the building is accommodating 20% more than was planned, it must be accommodating 120% of the number planned. 120% = 1.20

Then, 1.20 × the number planned = 750.

1.20 × ? = 750

If the product and one of two numbers are given, the missing number is found by dividing the product by the known number. 750 ÷ 1.20 = 625

The building was planned for 625 pupils.

Check: 1.20 × 625 = 750.

Find a number when:

	a	*b*
2.	20% more than it is 72	20% less than it is 120
3.	33⅓% more than it is 240	25% less than it is 450
4.	15% less than it is 34	10% more than it is 385
5.	150% more than it is 125	30% less than it is 630

6. In a recent year the number of deaths caused by automobile accidents increased 10%. If there were 1,870 deaths due to automobile accidents in that year, what was the number the previous year?

7. A man said, "My living expenses have increased 50% within the past five years and I am now spending $45 a week to support my family." How much was he spending five years ago?

ORDERING FROM A CATALOGUE

1. Mr. Baker, athletic director of Valley View High School, orders equipment from a sporting goods catalogue.

First-quality baseball uniforms are priced in the catalogue at $24, with 20% off to schools. What does Mr. Baker pay for each uniform?

$$20\% = .20 = .2 \qquad .2 \times \$24 = \$4.80$$
$$\$24 - \$4.80 = \$19.20$$

a. What do you call the price, $24, as listed in the catalogue?

b. What do you call the amount, $4.80, deducted from the list price?

c. What do you call the list price less the discount ($19.20)?

Find the net price of the following:

List Price	Discount	List Price	Discount
2. $350	8%	5. $95	24%
3. $625	28%	6. $105	$33\frac{1}{3}\%$
4. $721	35%	7. $450	16%

8. The list price of an automobile at the factory is $1045. If the dealer is allowed a discount of 24%, find the net cost of the car to the dealer.

9. Find the net cost of tennis balls, listed at 40¢ each, discount $37\frac{1}{2}\%$.

10. A table, listed in a catalogue at $37.50, cost the dealer $22.50. What rate of discount was allowed?

11. Mr. Baker ordered athletic equipment listed at $720. He paid $540. What rate of discount was he allowed?

*12. An automobile is marked to sell for **a** dollars, but a trade discount of **r** per cent is allowed. What is the amount of the discount? What is the net cost of the car?

SUCCESSIVE DISCOUNTS

A buyer may be allowed two or more discounts. He may be given an ordinary trade discount, a second discount for prompt payment, and a third discount for any one of several reasons, such as an unusually large order.

1. The list price of a radio was $120. The dealer, however, allowed a discount of 20% to a school and a second discount of 5% for cash. What was the net cost of the radio?

20% = .20; 5% = .05; list price = $120.
.20 × $120 = $24, amount of first discount.
$120 − $24 = $96, price after deducting the 20% discount.
.05 × $96 = $4.80, amount of second discount.
$96 − $4.80 = $91.20, price after deducting the second discount. The net price of the radio was $91.20.

To find the net price when two successive discounts are given, find the net price after either discount has been taken. Use this net price and repeat the process with the other discount.

Find the net price:

	LIST	DISCOUNTS		LIST	DISCOUNTS
2.	$600	20%, 10%	5.	$48.50	10%, 2%
3.	$480	20%, 12½%	6.	$3800	25%, 10%
4.	$90	10%, 5%	7.	$37.50	33⅓%, 2%

8. Mr. Wells bought goods amounting to $360 at discounts of 25% and 10%. Find the net cost of the goods.

9. Using the figures in problem 8, find the discount at 10% first; then the discount at 25%. Does the order in which the discounts are taken make any difference?

BUDGETING AN INCOME

The Jones family has an income of $2000 a year. People who know a great deal about family budgets say that the Jones' should spend their income about as follows:

Living	52%	Clothing	12%
Food	25%	Miscellaneous	11%

1. What per cent of income is allotted to each item?

2. How much money is allotted to each item?

3. A savings bank suggests budgets for families with incomes as given in the table. What is the yearly income of each family?

Budget Items	$25 wk.	$30 wk.	$40 wk.	$50 wk.	$60 wk.	$80 wk.	$100 wk.
Food	$8.00	$9.00	$10.00	$12.00	$13.00	$15.00	$17.00
Clothing	2.50	3.00	4.00	5.00	6.00	8.00	10.00
Shelter	6.00	7.00	10.00	12.00	15.00	20.00	22.50
Operating expenses	2.50	3.00	4.50	5.50	6.50	9.00	11.00
Health — recreation	1.50	2.00	3.00	4.00	5.00	8.00	10.50
Automobile	1.00	1.50	2.50	3.00	3.50	6.00	8.00
Savings	1.25	1.50	2.00	3.00	3.50	4.50	6.00
Insurance	1.25	1.50	2.00	2.50	3.50	4.50	6.00
Miscellaneous	1.00	1.50	2.00	3.00	4.00	5.00	9.00
Total	$25.00	$30.00	$40.00	$50.00	$60.00	$80.00	$100.00

4. What per cent of income may wisely be spent:
   - *a.* for food by a $50 a week family?
   - *b.* for clothing by a $30 a week family?
   - *c.* for shelter by a $60 a week family?
   - *d.* for operating expenses by an $80 a week family?
   - *e.* for recreation by a $25 a week family?
   - *f.* for insurance by a $40 a week family?

5. What per cent of income should be saved by each family group represented in the suggested budgets?

Buying in quantities is sometimes more economical than in small lots.

1. What per cent may be saved by buying soap at 3 cakes for 25¢ instead of three cakes at 10¢ a cake?

3 × 10¢ = 30¢, the cost of 3 cakes at 10¢ each.
30¢ − 25¢ = 5¢, amount saved by buying in quantity.
5¢ ÷ 30¢ = $.16\frac{2}{3}$ = $16\frac{2}{3}\%$, the per cent saved.

To find the per cent saved by buying in quantities, divide the difference between the two costs by the greater cost.

2. A round-trip railroad ticket between two places costs 55¢, a one-way ticket 35¢. What per cent is saved by buying a round-trip ticket instead of 2 one-way tickets?

3. Potatoes are sold in 75-pound bags at $1.75, or 42¢ a peck. What per cent may be saved by buying in quantities of 75 pounds instead of by the peck? (1 peck = 15 lb.)

4. A dealer sells coal at $10.50 a ton with 50¢ off for cash if the bill is paid within 10 days. What per cent off is allowed for prompt payments?

5. At a "special sale," 3 neckties were sold for $2. If the regular price of each necktie was $1, what per cent was saved by buying three at a time?

6. Tennis balls sell at 35¢ each, or $3.75 a dozen. Henry uses about a dozen tennis balls during the season. What per cent can he save by buying by the dozen?

7. Kathryn and Marion live near the city. Kathryn bought a 50-trip bus ticket for $8.50 and Marion bought a 10-trip ticket for $2.20. If each girl makes 50 trips to the city, what per cent is Kathryn saving?

MARGIN, EXPENSE, PROFIT

"You see that box of crackers?" said a grocer to one of his customers. "They cost me 12¢ a pound. I sell them for 18¢ a pound and lose money on every pound." John overheard the conversation and asked the grocer to explain. "**Selling price,**" continued the grocer, "must cover the **cost** of an article plus my **margin.** Out of the margin I pay such expenses as taxes, rent, heat, light, advertising, and wages, and usually have some money left for profit. These crackers, however, are too expensive to handle. They break so easily! I have no profit."

Each dollar which the grocer or any other merchant receives from the sale of merchandise is called the **sales dollar.** A shoe dealer divided his sales dollar as shown at the bottom of the page.

1. What per cent of the dollar is cost? profit? expense? margin?

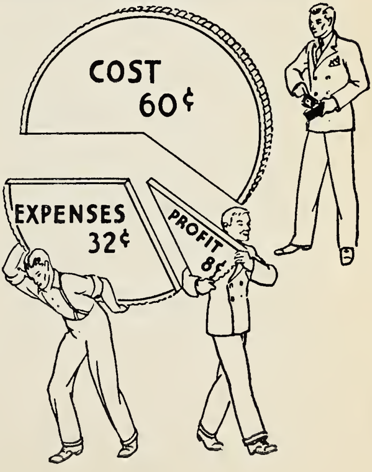
2. If a fur coat sold for $225 and the cost was $110, what was the margin?

3. A sweater, which cost $6, was disposed of at a sale for $4. What was the per cent loss on the sweater?

4. A rug, which cost $40, was sold for $55. If the expenses were $20, was there a profit or loss? how much?

*5. If cost plus margin equals selling price, is there a gain or loss?

*6. If cost and margin are equal, the selling price is how many times the cost?



Find the missing values in the following:

	Cost	Margin	Expenses	Profit	Loss	Selling Price
1.	\$24.25	?	\$6.25	\$4.50	-	?
2.	\$2.60	\$0.90	\$0.55	?	-	?
3.	\$5.75	\$2.40	\$3.05	-	?	?
4.	\$0.87	?	?	\$0.27	-	\$1.50
5.	\$89.75	\$60.25	\$30.75	?	-	?
6.	?	\$2.35	?	\$0.75	-	\$7.80
7.	\$12.40	?	\$3.55	-	?	\$12.95

8. A table which cost \$16 was sold for \$28. If the expenses of selling were \$7, what was the profit?

9. A car was sold at a margin of \$90, but the expenses of selling were \$40. What was the profit?

10. Mr. White sold a house for \$3500 which had cost him \$3750. What was his loss?

11. Mr. Cook said that he could not operate his business on less than a 25% margin. If his expenses are 14% of his sales, what per cent is profit? What is his profit on an article that sells for \$17.50?

*12. Using s for selling price, c for cost, and m for margin, write formulas for s and c.

*13. Using m for margin, e for expenses, and p for profit, write formulas for m and e.

*14. Using l for loss, c for cost, and s for selling price, write formulas for c and s.

*15. If s represents selling price; c, cost; m, margin; p, profit; e, expenses; and l, loss, which of the following formulas are correct: *a.* $c = s - e$; *b.* $l = s - c$; *c.* $m = s - c$; *d.* $e = m - c$; *e.* $p = m - e$; *f.* $s = c + m$.

USING THE VOCABULARY OF ARITHMETIC

Below are terms used in this chapter. State what each term means, or use it correctly in a sentence. If you do not know the meaning, turn to the key page in parentheses.

budget	(81)	per cent	(59)
sales dollar	(83)	profit	(83)
discount	(79)	selling price	(83)
margin	(83)	successive discounts	(80)
net price	(79)	trade discount	(80)

REVIEW OF PER CENT

Set I

Find the missing numbers without the use of pencil.

1. 10% of 60 = ?
2. 150% of 20 = ?
3. 50% of 600 = ?
4. 20 = ? % of 40
5. 60 = ? % of 30
6. 8 = ? % of 32
*7. 12 = 25% of ?
*8. 14 = 50% of ?
9. 25% of 200 = ?
10. 1% of 500 = ?
11. $33\frac{1}{3}$% of 90 = ?
12. 10 = ? % of 50
13. 17 = ? % of 100
14. 9 = ? % of 27
*15. 16 = 10% of ?
*16. 5 = 1% of ?

Set II

Use pencil to find the missing numbers.

1. 14% of 72 = ?
2. 210% of 55 = ?
3. $\frac{1}{2}$% of 450 = ?
4. 9 = ? % of 14
5. 27 = ? % of 135
6. 360 = ? % of 400
*7. 15 = 30% of ?
*8. 32 = 16% of ?
9. 36% of 125 = ?
10. 16.5% of 320 = ?
11. 4.5% of 175 = ?
12. 12 = ? % of 7
13. 81 = ? % of 45
14. 24 = ? % of 90
*15. 18 = 90% of ?
*16. 120 = 12% of ?

HOW WELL DO YOU REMEMBER?

1. Write as per cents: *a.* .1; *b.* .03; *c.* 1.04; *d.* $\frac{1}{2}$; *e.* 2; *f.* .005; *g.* $\frac{3}{4}$; *h.* 2.5.

2. Express as decimals or whole numbers: *a.* 40%; *b.* $1\frac{1}{2}\%$; *c.* 2%; *d.* $\frac{1}{2}\%$; *e.* 104%; *f.* 100%.

3. Write as fractions: *a.* 20%; *b.* $33\frac{1}{3}\%$; *c.* 75%; *d.* $12\frac{1}{2}\%$; *e.* 50%; *f.* $66\frac{2}{3}\%$; *g.* 80%.

4. On a spelling test of 25 words, Sarah made a score of 92%. How many words did she misspell?

5. An automobile dealer received a discount of 24% on the price of new cars. How much does he pay for a car which is marked to sell at $1350?

6. Over a period of 10 years the average price of electric refrigerators dropped from $220 to $140. What was the per cent reduction?

7. A kitchen sink is listed in a catalogue at $80. Find the net cost to a plumber if he is given discounts of 40% and 10%.

8. A merchant marked a suit that cost him $15 at 50% above cost. What was his margin?

9. A pair of shoes, costing $3, was sold for $5. What was the profit, if expenses were 15% of the sales price?

10. Chewing gum sells at 5¢ a package or 3 packages for 10¢. What per cent of the cost of single packages may be saved by buying in quantities of three?

***11.** If 40% of a number is 72, what is the number?

***12.** An agent sold automobile accessories on a commission of 40%. If his sales amounted to $96 in one week, what was his commission?

***13.** Mr. Bell earned $30 one week working on a commission of 20% of his sales. What was the amount of his sales for the week?

THINGS TO REMEMBER

1. *How to change a decimal to a per cent and a per cent to a decimal.*

2. *How to change a fraction to a per cent and a per cent to a fraction.*

3. *How to find a per cent of a number.*

4. *How to find what per cent one number is of another.*

*5. *How to find a number when a per cent of it is given.*

TEST ON CHAPTER III

1. How is a decimal or a common fraction changed to a per cent? Change the following to per cents: *a.* .5; *b.* $\frac{3}{8}$; *c.* 1.035; *d.* .004; *e.* $\frac{3}{5}$; *f.* 1; *g.* $1\frac{1}{2}$.

2. How is a per cent changed to a decimal? Change the following per cents to decimals: *a.* 3%; *b.* $\frac{1}{2}$%; *c.* $1\frac{3}{4}$%; *d.* 104%; *e.* 150%; *f.* 102.5%.

3. A car is listed at $1315 at the factory, delivered price $1450. What per cent of the factory price is the delivered price (answer to nearest tenth per cent)?

4. If a dealer sold the car (problem 3) at the delivered price, commission for selling 24%, what was his commission?

5. Find the net cost of a shipment of goods, marked $650, when discounts of 20% and 5% are allowed.

6. The subscription price of a magazine is $2 a year, $3.50 for two years, $5 for three years. What per cent of the yearly rate is saved by a two-year subscription? a three-year subscription?

7. A suggested budget for a family income of $1200 is as follows: Food, 35%; rent, 25%; clothing, 8%; house operation, 7%; savings, 8%; miscellaneous, 17%. Find the amount of each item in the budget.

*INFORMATION PLEASE!

1. List twenty ways in which per cent is used. Classify each use under one of the three kinds of per cent examples about which you studied in this chapter.

2. How does a merchant determine whether or not his advertising pays?

3. Certain manufacturers sell direct to the **consumer** (person who uses the goods), not through **middlemen** (wholesale or retail dealers). What does this mean? List 5 products sold direct; 5 through middlemen. Which method of selling is more common? Why?

4. Give illustrations to show that the amount earned working on commission depends upon: (*a*) the rate of commission; (*b*) the rate of commission and the selling price of an article; (*c*) the rate of commission, the selling price of an article, and the number of articles sold.

5. The amount of "mark-up" is an important item in the number and the size of discounts which a merchant may give. Show why this is true.

A MAGIC SQUARE

On the right is a magic square with some of the cells vacant. Construct a square containing 36 cells, copy the numbers given, and supply those which are missing.

?	37	42	62	55	60
39	?	43	57	?	61
67	45	?	58	63	?
?	64	69	53	46	51
66	41	70	48	50	52
40	72	65	?	54	?

PROGRESS TEST

If you make errors on this test, turn to the key pages in parentheses where the work is explained.

1. $5\frac{3}{4} - 1\frac{5}{8} = ?$ (15)

2. $\frac{7}{8} \div 4\frac{1}{4} = ?$ (18)

3. $7000 - 5008 = ?$ (8)

4. $8\frac{1}{2} \times \frac{5}{6} = ?$ (16)

5. $1.4 \times 3.8 = ?$ (21)

6. $9768 \div 47 = ?$ (13)

7. $5.7456 \div 1.68 = ?$ (25)

8. $3\frac{1}{4} \times 8\frac{3}{4} = ?$ (16)

9. $9\frac{3}{8} + 6\frac{1}{2} + 7\frac{3}{4} + 2\frac{7}{16} + 4\frac{5}{8} = ?$ (15)

10. $3.542 + 0.915 + 0.050 + 1.465 + 2.449 = ?$ (20)

11. Round off the following to the nearest hundredth: *a.* .458; *b.* .1349; *c.* .995; *d.* .6975. (27)

12. If $\frac{7}{8}$ of a yard of cloth costs 84¢, what is the cost of one yard? (73)

13. Find the area of a triangle having a base of 19 inches and an altitude of 15 inches. (40)

14. If a circle has a diameter of 14 feet, what is its area? (Use $\pi = \frac{22}{7}$) (50)

15. Prove that there are 144 square inches in one square foot. (38)

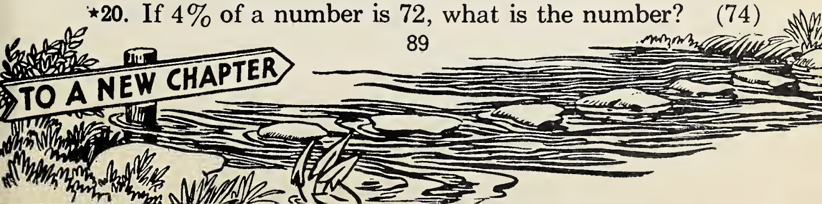
16. What is the difference between an equilateral triangle and an isosceles triangle? Draw each. (42)

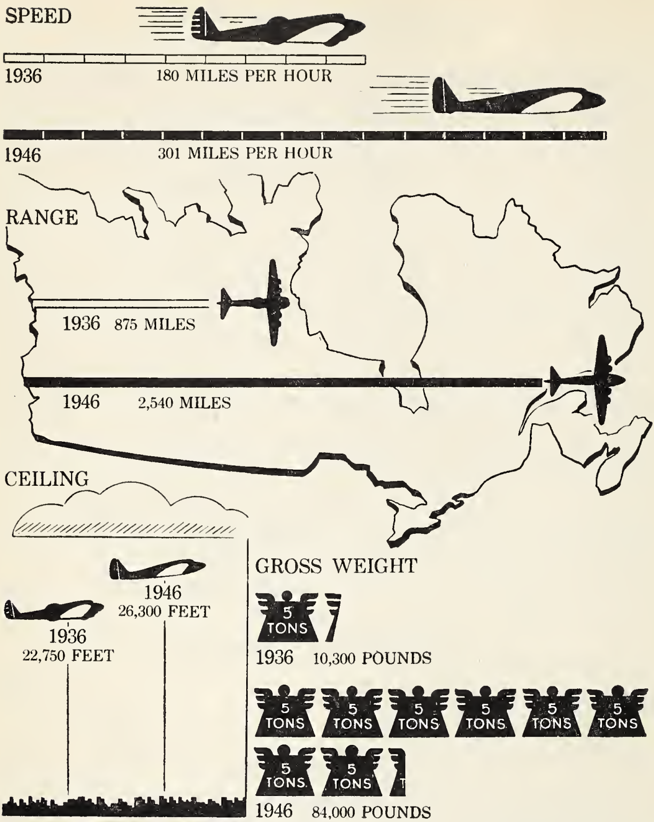
17. If a bicycle wheel is 28 inches in diameter, how far will it move in one revolution? (Use $\pi = \frac{22}{7}$) (48)

18. In a class of 36 pupils there are 20 girls. What per cent is girls? (66)

19. How much is 5% of $675? (65)

★20. If 4% of a number is 72, what is the number? (74)





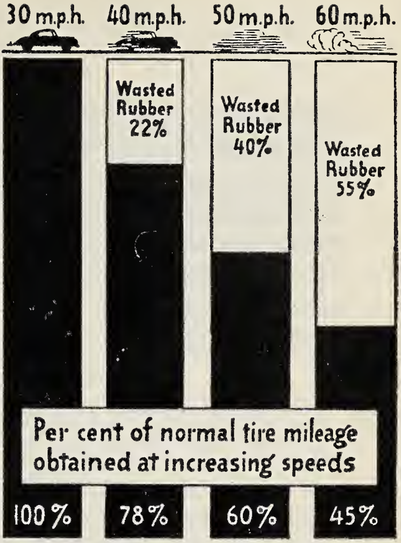
Here are four **pictographs** which tell a thrilling story of Canada's airplane development. You can see at a moment's glance the increase in airplane speed, range, flying height, and weight. The facts for 1936 are based upon the Lockheed Electra, while the facts for 1946 are based upon the D.C.-6. Explain what each pictograph means.

CHAPTER IV

GRAPHS TELL THE STORY

Number facts about things and people can usually be understood more easily in the form of a graph than by a table of figures. You have read and constructed many graphs. Now you will continue your study of this common way of showing the relationship between quantities.

Your father, for example, wants to get the best possible mileage out of his tires. This graph shows one way to do so.



1. At what speed may he drive with ordinary wear on his tires and no waste of rubber?

2. What per cent of rubber will he waste at a speed of 40 miles an hour? 50 miles? 60 miles?

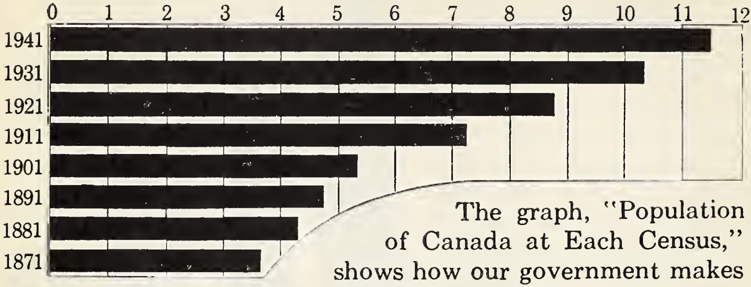
3. The amount of rubber wasted at 60 miles an hour is how many times as much as at 40 miles an hour?

4. "Keep this tire inflated to 35 pounds, drive not over 30 miles an hour, and the tire will last 25,000 miles," said a tire dealer. What would be a safe guarantee on this tire if the speed were 40 miles an hour? 50 miles? 60 miles?

5. At what speed is a driver wasting about half the normal (ordinary) mileage in his tires?

*6. Estimate from the graph the mileage wasted in tires at a speed of 70 miles an hour.

POPULATION OF CANADA AT EACH CENSUS
(POPULATION IN MILLIONS)



The graph, "Population of Canada at Each Census," shows how our government makes and uses bar graphs.

1. What was the largest number to be graphed?

2. Into how many blocks is the graph divided horizontally?

3. How many people are represented by each block?

4. Are the bars equal in width or do they vary in width? the spaces between the bars?

5. Are the spaces between the bars wider or narrower than the bars? Why?

6. Suppose this graph began at 1 million, not zero. Would it be more or less accurate than as shown? Why?

7. Select a scale to be used if the greatest number of spaces on a graph is 10 and the number for each bar is

a. 9 *c*. 92 *e*. 890 *g*. 6745
b. 36 *d*. 138 *f*. 943 *h*. 12,396

8. Show by means of a bar graph the number of telephones to each 100 people in the following countries:

United States	16	Australia	10
Great Britain	7	Union of South Africa	2
Canada	12	China	.04
Argentina	3	New Zealand	13

9. The average yearly earnings for certain occupations are as follows. Show these earnings by use of a bar graph.

Medicine	$4970	Ministry	$1960
Engineering	4460	Skilled trades	1410
Architecture	3790	Nursing	1295
Library work	1990	Unskilled labour	785

10. The average lifetime earnings of the eight groups (problem 9) are as follows. Show these earnings by use of a bar graph.

Medicine	$239,000	Ministry	$87,000
Engineering	238,000	Skilled trades	62,800
Architecture	205,000	Nursing	23,000
Library work	94,000	Unskilled labour	12,900

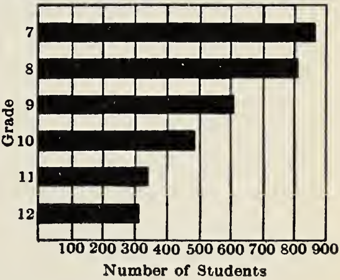
11. Using the data in problems 9 and 10, find the number of years (to the nearest whole number) each group of people works at its trade or profession.

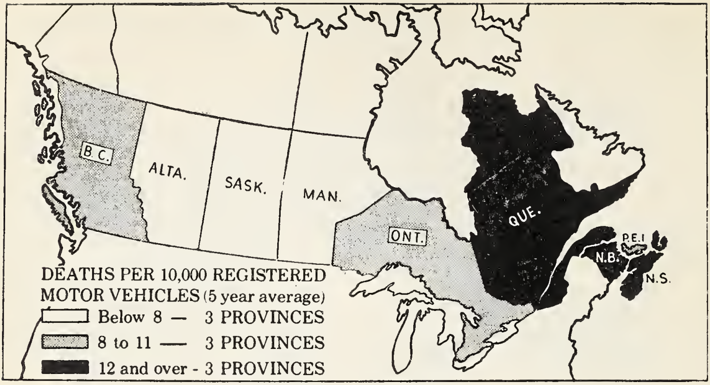
12. The question "How long do pupils remain in school?" was answered by a study of the records of 1,000 boys and girls. The results of the study are shown in the graph. One space or unit on the graph represents how many pupils?

13. About how many pupils remained in school through Grade 7? Grade 8? Grade 9? Grade 10? Grade 11? Grade 12?

★14. Between which two grades was there the greatest per cent "dropping out" of school?

★15. What per cent of the pupils in Grade 7 graduated from high school?




B.C.
ALTA.
SASK.
MAN.
ONT.
QUE.
P.E.I
N.B.
N.S.
DEATHS PER 10,000 REGISTERED MOTOR VEHICLES (5 year average)
☐ Below 8 — 3 PROVINCES
▨ 8 to 11 — 3 PROVINCES
■ 12 and over - 3 PROVINCES

SAFE DRIVING

Sue clipped the map graph from her local newspaper and brought it to class with the remark that she did not believe the number facts as shown on the graph were correct. After you have studied the graph, tell what you think.

1. What is the title of the graph?

2. What kinds of vehicles must be included in any study of motor-vehicle registrations?

3. What does black indicate on the map? white? the shading?

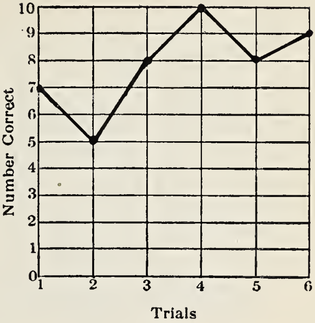
4. Give the deaths per 10,000 vehicles in Nova Scotia; Manitoba; Ontario; the province in which you live. (If your province is named above, choose Saskatchewan.)

5. In which part of the country is the number of deaths per 10,000 vehicles the greatest?

*6. Would you say from the graph that dense population was or was not the chief cause of fatal accidents? Explain.

*7. Asked why she did not like the graph, Sue said, "The blocks of provinces are too even. All the provinces marked black are in the east; all the prairie provinces are 'white'." Tell how you would check the correctness of this graph in order to satisfy Sue.

BROKEN-LINE GRAPHS



Jim's record of the number of problems solved correctly on six different arithmetic tests is given in the following table, and shown on the graph.

Trial	1	2	3	4	5	6
Correct	7	5	8	10	8	9

1. On which scale, the vertical or the horizontal, are the "numbers correct" shown? the "trials"?

2. What kind of paper is used, ruled or graph? Could the other kind have been used?

3. What is the largest number to be graphed on the vertical scale? the horizontal?

4. What does each division on the horizontal scale represent? the vertical?

5. Suppose Jim took 100 tests and had 100 examples in each test. What scale divisions would you recommend?

6. How many examples did Jim work correctly in "trial 3"? What two lines cross to fix this point on the graph?

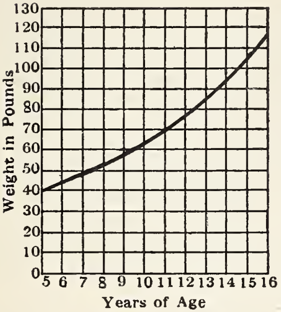
7. The average cost of a bushel of potatoes in January was $2.40; in March, $3.36; May, $2.64; July, $2.10; September, $1.82; November, $1.72. Show these prices by a broken-line graph.

8. A motorist who gets 18 miles to a gallon of fuel at 30 miles an hour, will get about:

16 miles to a gallon at 40 miles an hour
15 " " " " " 50 " " "
13 " " " " " 60 " " "
11 " " " " " 70 " " "

Show this fuel use by a broken-line graph.

CURVED-LINE GRAPHS



A curved-line graph may be used to show a gradual change from one amount to another; as, for example, the increase in the average weight of boys from ages 5 to 16.

1. About how much should be the weight of a boy 6 years of age? 12 years? 15 years?

2. About what should be the age of a boy who weighs 50 pounds? 75 pounds? 100 pounds?

3. If you double your age, do you double your weight? more or less, and how much?

4. About how much should a boy of 11 years weigh? Which two lines cross to give you this point?

5. Exactly how much should a boy of 8 years weigh? Why cannot this be answered from the graph?

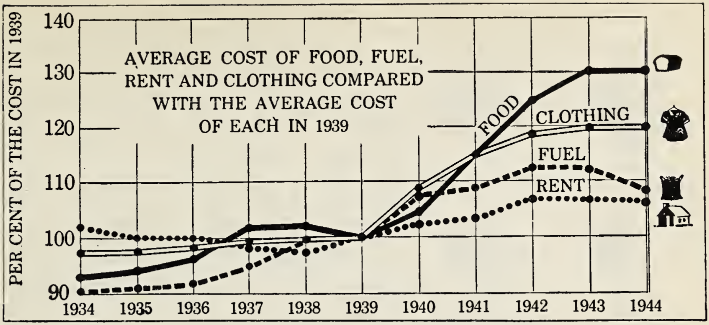
6. Should a boy of 8 years weigh more or less than 50 pounds? Why? More or less than 60 pounds? Why?

7. Would you judge from the graph that a boy of 8 years should weigh 53 pounds? 54 pounds? or 55 pounds?

8. From the ages given on the graph, during which years should a boy gain at least 10 pounds each year?

9. At automobile proving grounds, cars are driven at various speeds, brakes applied, and the stopping distance measured. Show on a curved-line graph the stopping distance for each speed given below.

Miles an hour	10	20	30	40	50	60	70
Stopping distance (feet)	6	22	50	88	138	200	272



UPS AND DOWNS OF LIVING COSTS

1. What necessary things which your family buys are shown on this graph?

2. What period of time is covered by the graph?

3. The cost of an article in 1939 is represented on the graph by what per cent?

4. The cost of clothing in 1942 is compared with its cost in what year?

5. The cost of fuel in 1934 is compared with its cost in what year? of rent? of food?

6. Which of the commodities shows the greatest change in cost over the span of years covered by the graph?

7. Would a dollar spent for fuel in 1944 purchase more or less fuel than in 1939? a dollar spent for rent? for food? for clothing?

8. If a suit cost $40 in 1939, about what did it cost in 1944?

9. During what year did the per cent cost of food rise most sharply? the per cent cost of fuel? of clothing?

10. About how much were these increases (problem 9)?

*11. What caused living costs to rise after 1939?

*12. Why did living costs rise less rapidly after 1942 than in the period 1939-1942?

THE FARMER'S SHARE

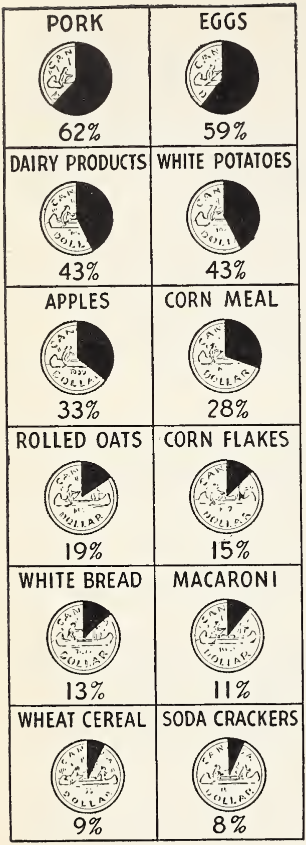


FIG. A.—How to read this circle graph: The farmer who raises hogs to sell receives 62%, or 62¢, of each dollar spent for pork products by consumers.

You spend $1 for food at a store. How much of that "food dollar" goes to the farmer who produced the food?

The answer for certain food products is given in Figure A.

1. Figure A is a **circle** graph. Why is it so called? Sometimes this form of graph is called a "pie graph." Why?

2. The farmer receives at least half the food dollar for what foods shown on the graph? at least one fourth the food dollar for what foods?

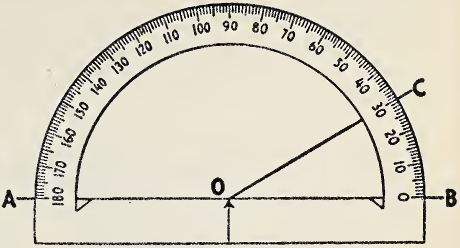
3. The farmer receives what per cent of the food dollar for rolled oats? for apples? for white bread?

*4. Why does the farmer receive such a small percentage of the food dollar for wheat cereal?

*5. Name some of the things, other than the farmer's share, which help to add to the cost of a food product.

*6. The farmer's share of the food dollar changes from year to year. What are some of the things which produce this change?

HOW TO CONSTRUCT CIRCLE GRAPHS



You should know how to construct as well as how to read (page 98) circle graphs. To do this job accurately, you must test your skill in using a protractor to draw an angle of any given size.

1. Suppose your problem is to draw an angle of 30° to line *AB*. Where would you place the straight edge of the protractor?

2. Where would you place the centre point of the protractor?

3. What two points would you connect to form the 30° angle *BOC*?

4. Use your protractor to draw an angle of: *a*. 45°; *b*. 165°; *c*. 38°; *d*. 115°; *e*. 72°; *f*. 143°.

5. To construct a circle graph, proceed as follows:

a. If the numbers given are not expressed as per cents, find their sum.

b. Find what per cent each number is of the total number to the nearest whole per cent.

c. Multiply 360 degrees by each per cent found in *b*. Each product represents the number of degrees in each angle to be drawn at the centre of the circle.

d. Draw a circle with any convenient radius. With the use of a protractor, draw the angles at the centre which you found in *c*.

e. Seldom should more than six items be represented on a circle graph.

CONSTRUCTING CIRCLE GRAPHS

Construct circle graphs from the following data:

1. A merchant said that the selling price of each article sold in his store was made up of: cost, 65%; expense, 30%; profit, 5%.

2. Retail sales in Canada in a recent year were distributed as follows: Independent stores, 70%; chain stores, 19%; department stores, 11%.

3. Of Canada's total land area about 16% is agricultural land, 28% is forested, and 56% is waste or unproductive land.

4. Of 1000 boys and girls who start school in Canada at the present time, about 800 continue to grade 8, about 480 to grade 10, about 275 to grade 12, and about 30 graduate from college.

5. A budget plan for a family of three, yearly income of $1800, calls for the following amounts: savings, $240; food, $540; clothing, $240; housekeeping expenses, $150; rent, $240; education, recreation, and charities, $240; miscellaneous, $150.

*6. The gainfully employed of Asia spend 90% of their earnings for food and 10% for the comforts of life; those of Europe spend 80% for food and 20% for the comforts of life; those of Canada, 30% for food and 70% for the comforts of life. Draw three circles of equal size, one for each continent or country. Show these relationships by use of circle graphs.

*7. What conclusion do you draw from the graphs in problem 6 about the standard of living in Asia and Europe compared with that in Canada?

HOW WELL DO YOU REMEMBER?

1. Name four kinds of graphs. Of these four, which is the easiest to read? the most difficult to construct? Why?

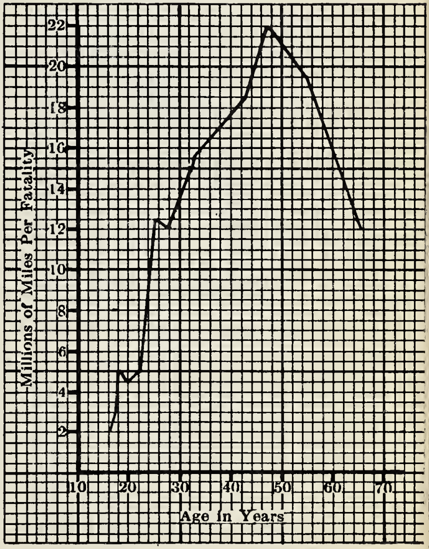
2. What is meant by the scale of a graph?

3. If age and weight are represented on a line graph, which should be shown along the vertical scale?

4. The average yearly earnings for certain occupations are given below. Show these earnings by a bar graph.

Dentistry	$4230	School teaching	$1335
College teaching	3020	Office typing	1070
Social work	1680	Farm labor	475

5. "Who have the most fatal (causing death) automobile accidents: young people, middle-aged, or old people?" This question is answered in the graph.



a. How many different age groups are shown on the graph?

b. In which age group is the number of millions of miles travelled the greatest for each fatal accident? the smallest?

c. Persons 20 years of age have one fatal accident to about how many million miles of driving? persons 30 years of age? 40? 50? 60?

d. According to the graph, who is the safest driver: the youth? the middle-aged person? the aged person?

THINGS TO REMEMBER

1. *How to read pictographs.*

2. *How to read, to make, and to find an appropriate scale for bar graphs, line graphs, and circle graphs.*

TEST ON CHAPTER IV

1. If you wished to show temperature during certain hours of a day, would it be better to use a bar graph or a line graph? Why?

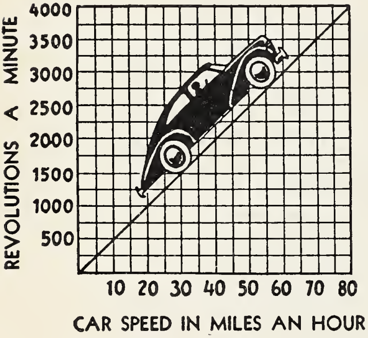
2. If a bar graph is not to have more than 12 units, what unit would you use when the largest number to be graphed is: *a*. 10? *b*. 109? *c*. 218? *d*. 1765?

3. An automobile engine revolves faster or slower according to the speed of the car.

a. How many revolutions does the motor make when the car has a speed of 20 miles an hour? 25 miles an hour?

b. How many times the revolutions at 25 miles an hour does the motor revolve at 50 miles an hour?

c. When the motor makes 2750 revolutions a minute, what is the speed of the car?



4. In a recent year, 59% of deaths resulting from motor accidents occurred at night and 41% during daylight. Show these amounts by a circle graph.

5. If there were 1500 deaths resulting from motor accidents during the above year, how many occurred at night? during daylight?

⋆TOPICS FOR SPECIAL REPORTS

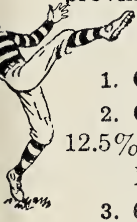
1. If the scale of a bar or line graph does not begin at zero, the graph usually does not show the facts correctly. Why is this true?

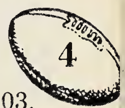
2. A man is earning three times as much to-day as he did 10 years ago. This fact is shown by two coins, one coin three times the diameter of the other. Why is this graph incorrect?

3. Bring to class different kinds of graphs from newspapers or magazines and show why they are or are not well constructed.

4. Find the value of the four most valuable crops grown in your province and represent these facts by a graph.

5. Find the population of the four largest cities in your province and represent these facts by a graph.





LET'S PRACTISE PERCENTAGE

1. Change to per cents: *a.* .7; *b.* 1.4; *c.* 3; *d.* $\frac{1}{1}$; *e.* 1.03.

2. Change to decimals: *a.* 12%; *b.* 105%; *c.* 3%; *d.* 12.5%; *e.* 2.5%; *f.* 180%.

Find the missing numbers in the following:

3. 6% of 75 = ?
4. $\frac{1}{2}$% of 920 = ?
5. 14 = ? % of 56
6. 40 = 5% of ?
7. 147 = ? % of 147
8. $\frac{1}{2}$% of 340 = ?
9. 125% of 350 = ?
10. 300% of 28 = ?
11. 72 = ? % of 18

⋆12. 64 = 16% of ?

⋆13. 45 = 150% of ?

14. $\frac{1}{2}$ = ? % of 1
15. Fifty per cent more than 38 is (?).
16. Forty per cent less than 50 is (?).
17. What per cent less than 50 is 30 (?).

PROGRESS TEST

If you make errors on this test, turn to the key pages shown in parentheses where the work is explained.

1. $9\frac{3}{4} + \frac{5}{6} + 8\frac{1}{2} = ?$ (15)
2. .938 + .045 + .506 + .325 = ? (20)
3. 151.776 ÷ 3.72 = ? (22)
4. 17.5% of 350 = ? (65) **5.** 11 = ? % of 25 (66)
6. $18 = \frac{3}{4}$ of ? (73) **7.** $5\frac{3}{5} \div 1\frac{2}{5} = ?$ (18)
8. $7\frac{1}{2} \times 5\frac{3}{4} = ?$ (16) **9.** 10,000 − 1486 = ? (8)
10. $\frac{1}{2}$% of 550 = ? (72)
***11.** 16 = 4% of ? (74)
12. 140 = ? % of 35 (66)

13. Round off the following to the nearest tenth: *a*. .449; *b*. 5.95; *c*. 1.945; *d*: .055; *e*. 1.045. (27)

14. A rectangular floor is 21 feet long and 14 feet wide. If a rug $16\frac{1}{2}$ feet long and 12 feet wide is placed on the floor, how much floor space is not covered by the rug? (37)

15. When the price of a dozen oranges decreases from 50¢ to 42¢, what is the per cent decrease? (69)

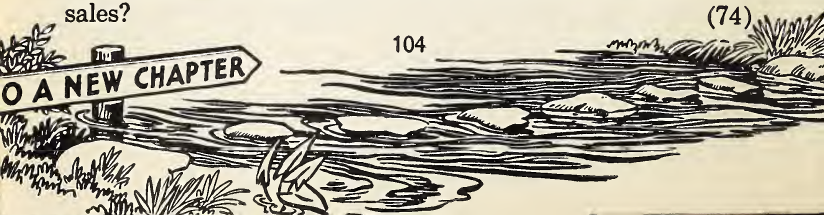
16. Express as per cents: *a*. $\frac{3}{4}$; *b*. $\frac{5}{6}$; *c*. .025; *d*. $7\frac{5}{8}$; (59) *e*. 1.7; *f*. 1.025; *g*. $1\frac{1}{2}$; *h*. $\frac{2}{3}$. (61)

17. A merchant bought a table for $24. He marked it 50% above cost and then sold it at a discount of 20% of the marked price. What was his margin? (84)

18. If the population of a city doubles, what is the per cent increase? (69)

19. If two discounts of 10% and 10% are given on a typewriter, marked at $115, what is the net price? (80)

***20.** Mr. Wills earned $26 a week selling brushes. His commission was 40%. What were his weekly sales? (74)



CHAPTER V

RENTING MONEY

1. Frank Scott wanted an automobile to drive his family to the seashore, a distance of 140 miles there and back. He telephoned a rent-a-car agency for rates.

"First 40 miles, 15¢ a mile; 7¢ a mile thereafter plus a 50¢ service fee," answered the agency. What rental did Frank pay for the shore trip?

2. Mr. Scott, Frank's father, had a shoe store. He was ordering his fall and winter stock of overshoes.

"Your bill," said the rubber goods dealer, "comes to $300; but we can let you have 5% off for cash." What was the cash price of the overshoes?

3. Mr. Scott needed $200, over and above his cash on hand, to pay for the overshoes. He asked his bank for a loan.

"We charge 6%," said the banker, "6% a year." How much would the loan cost Mr. Scott a year? a month? three months? six months?

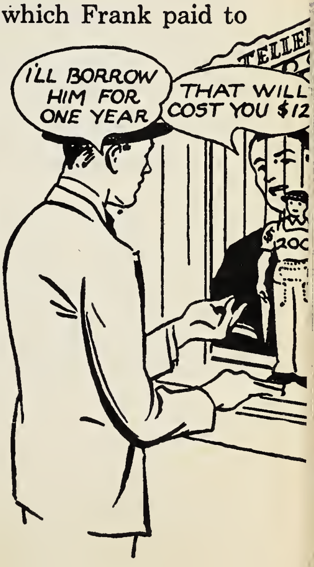
4. *a.* What do you call the charge which Frank paid to the rent-a-car agency for the use of its automobile?

b. The charge which Mr. Scott paid to the bank for use of its money?

c. What is interest?

5. "Loans up to $300 at 2% a month," advertised a small-loan association. What did the advertisement mean?

6. Interest at 6% a year is the same as what rate for 6 months? for 3 months? for 1 month?



PRINCIPAL—INTEREST—TIME—AMOUNT

1. *a.* Harry Miller borrowed \$150 from his father to buy a used car. He agreed to pay 5% interest for the use of the money. How much interest a year must he pay?

b. What do you call the \$150 which Mr. Miller loaned and Harry borrowed?

c. The "5%"?

d. The "one year"?

e. Using these three terms, write the rule for finding interest.

f. $I = prt$. What formula is this? What does the formula mean?

g. Find i when $p = \$250$; $r = 4\%$; $t = 2$ years.

h. If Harry paid interest on his loan every 6 months, how much would each payment be?

i. How much if he paid every 2 years?

2. At the end of the year Harry paid his father \$157.50. How much of this was principal? How much was interest? Principal plus interest equals the **amount** of the loan.

3. Using i for interest, p for principal, and a for amount, write the formula for the amount.

4. Find the amount of a loan of \$350 at 5% for 6 months.

5. Find the interest and amount:

	Principal	Rate	Time		Principal	Rate	Time
a.	\$400	5%	6 mo.	*d.*	\$600	6%	1 mo.
b.	\$750	4%	1 yr.	*e.*	\$200	4½%	4 mo.
c.	\$575	5%	1 yr.	*f.*	\$250	4½%	6 mo.

6. The interest on a loan of \$1000 for one year was \$55. What was the rate? (Think: \$55 = ? % of \$1000.)

HOW TO USE AN INTEREST TABLE

In finding the interest on a loan, banks use interest tables like this one.

SIMPLE INTEREST TABLE—RATE 6%

DAYS	$900	$800	$700	$600	$500	$400	$300	$200	$100
90	$13.315	$11.835	$10.356	$8.876	$7.397	$5.918	$4.438	$2.959	$1.479
60	8.877	7.890	6.904	5.918	4.932	3.945	2.959	1.973	.986
40	5.918	5.260	4.603	3.945	3.288	2.630	1.973	1.315	.658
30	4.439	3.945	3.452	2.959	2.465	1.973	1.479	.986	.493
20	2.959	2.630	2.301	1.973	1.644	1.315	.986	.658	.329
10	1.479	1.315	1.151	.986	.822	.658	.493	.329	.164
8	1.184	1.052	.921	.789	.658	.526	.395	.263	.132
5	.740	.658	.575	.493	.411	.329	.247	.164	.082
3	.444	.395	.345	.296	.247	.197	.148	.099	.049
2	.296	.263	.230	.197	.164	.132	.099	.066	.033
1	.148	.132	.115	.099	.082	.066	.049	.033	.016

1. To find the interest on $250 for 30 days at 6%, run your pencil down the $200 column until you come to the line which shows the interest for 30 days. The interest as shown is $.986. In the $100 column you find the interest on $100 for 30 days at 6%, or $.493. The interest on $50 is ½ of $.493 or $.247. Therefore the interest on $250 is $.986 plus $.247 or $1.23.

2. Find the interest on $750 at 6% for 63 days.

The interest on $700 for 60 da. = $6.904
The interest on $ 50 for 60 da. = ½ of $.986 or $.493
The interest on $700 for 3 da. = $.345
The interest on $ 50 for 3 da. = ½ of $.049 or $.025
The interest on $750 for 63 da. = $6.904 + $.493 + $.345 + $.025 = $7.767 or $7.77.

3. Using the interest table, rate 6%, find the interest for each of the following: $300 for 30 da.; $600 for 90 da.; $400 for 60 da.; $500 for 45 da.; $700 for 83 da.; $850 for 60 da.; $975 for 90 da.; $50 for 63 da.; $535 for 75 da.; $460 for 32 da.

FINDING INTEREST RATES

1. "The interest on that loan, Mr. Scott," said his banker, "will be $12 a year." If Mr. Scott had borrowed $200, what rate of interest was he paying?

i = $12 p = $200 r = ? $12 = ? % of $200

$\frac{12}{200} = .06 = 6\%$ Check: .06 × $200 = $12.

The rate of interest is 6%.

2. A letter from a small-loan company read, "We can let you have $300 at any time, and the cost to you will be only $7.50 for 3 months. What rate of interest was charged?

"Rate of interest" means the rate for one year.

3 months = ¼ year. If the interest for ¼ year is $7.50, the interest for one year is 4 × $7.50, or $30.

$30 = ? % of $300 $\frac{30}{300} = .1 = 10\%$

The rate of interest is 10%. **Check: .1 × $300 = $30.**

Find the rate of interest on the following:

	Principal	Interest	Time		Principal	Interest	Time
3.	$400	$24	1 yr.	9.	$500	$25	1 yr.
4.	$1000	$55	1 yr.	10.	$90	$18	1 yr.
5.	$750	$25	6 mo.	11.	$100	$8	6 mo.
6.	$1000	$20	4 mo.	12.	$1200	$20	3 mo.
7.	$1500	$50	8 mo.	13.	$600	$10	3 mo.
8.	$200	$4	8 mo.	14.	$300	$3	9 mo.

15. On a loan of $100 the interest charge was $1 a month. What was the rate of interest?

16. A small-loan company charges ¾% a month interest. What is the rate a year?

*INSTALMENT BUYING

The price of the refrigerator is $190; or $10 down and $10.55 a month for 18 months.

1. The instalment price is how much more than the cash price?

2. A radio, listed at $175, can be bought at 15% off for cash; or 20% of the list price down and $10 a month for 15 months. Find the difference between the cash price and the instalment price.

3. About 60% of all new automobiles are sold on the instalment plan, and the remainder on a cash basis. Show these facts by a circle graph.

4. Clifford gave the following reasons why the instalment price of an article should be more than its cash price. What does each statement mean? Why is it true?

- *a.* Extra bookkeeping is required.
- *b.* Frequently a collector is needed.
- *c.* Some articles have to be reclaimed.
- *d.* The merchant makes a loan to the customer and charges interest for the loan.

5. Betty reported to her class some advantages and disadvantages of instalment buying. What is meant by each?

- *a.* Instalment buying increases business.
- *b.* Instalment buying results in bad habits of thrift.
- *c.* Instalment buying enables people to enjoy many comforts of home that would otherwise be denied to them.
- *d.* The rate of interest charged is sometimes very high.

6. Debate this question in class: Resolved, That instalment buying should be encouraged in this country.

*CASH OR ON TIME?

In each of the following examples find how much above his cash price a merchant charged for articles sold on instalments.

Article	Cash Price	Down Payment	Monthly Payment	Number of Payments
1. Radio	$120	$30	$10	12
2. Used car	$385	$156	$23	12
3. Suit of clothes	$25	$5	$5	6
4. Set of books	$22	$2	$2	12
5. Washing machine	$59	$5	$5	12
6. Vacuum cleaner	$50	$7	$6	8

7. An electric clock is sold for $10 cash, or $2 down and $1 a month for 9 months.

8. The cash subscription price of a magazine is $5, or $1 down and $1 a month for 5 months.

9. A cedar chest is priced at $50 cash, or $5 down and $5 a month for 10 months.

10. A gas range sells for $93 cash, or $10 down and $10 a month for 10 months.

11. A store advertised a three-piece living room suite for $90 cash, or a down payment of $25 and 5 monthly instalments of $15 each.

12. An automobile finance company offers to make a loan of $300 for 6 months to be paid in 6 monthly instalments of $54.40.

13. A radio is marked $60 cash, or $5.50 a month for 12 months.

14. A small radio sells for $18 cash, or $2 down and $2 a month for 9 months. How much more is the instalment charge than interest on a loan of $16 at 6% for 9 months?

★INSTALMENT RATES

1. A radio sells for \$29 cash, or \$2.50 down and \$5 a month for 6 months. What rate of interest is equivalent to the additional cost of buying the radio on instalments?

Interest Formula: $i = prt$, therefore $r = \frac{i}{pt}$

i = \$32.50 — \$29 = \$3.50, added cost of buying on instalments

\$32.50 — \$2.50 (down payment) = \$30 (balance for one month)
30.00 — 5.00 (monthly payment) = 25 (“ “ “ “)
25.00 — 5.00 (“ “) = 20 (“ “ “ “)
20.00 — 5.00 (“ “) = 15 (“ “ “ “)
15.00 — 5.00 (“ “) = 10 (“ “ “ “)
10.00 — 5.00 (“ “) = 5 (“ “ “ “)
p = ... \$105 (total of unpaid balances for one month)

t = 1 month, or $\frac{1}{12}$ of a year

$$r = \frac{3.50}{105 \times \frac{1}{12}} \times \frac{12}{12} = \frac{42}{105} = \frac{2}{5} = 40\%$$ (check this work)

a. How much and how often did the unpaid balances decrease? Why?

b. Why does t in the formula equal $\frac{1}{12}$?

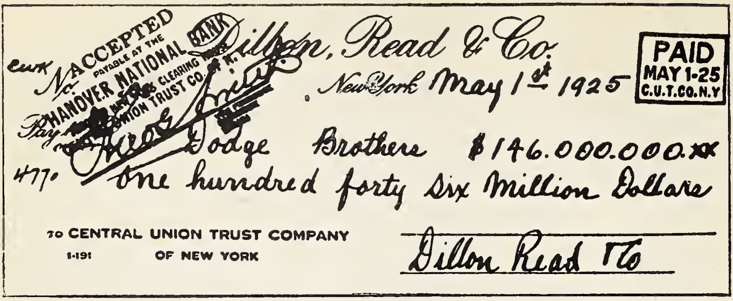
c. Why were both numerator and denominator of the fraction multiplied by 12?

d. What rate of interest is equivalent to the added cost of buying the radio on instalments?

2. A vacuum cleaner sells for \$65 cash, or \$5 down and \$8 a month for 8 months. What rate of interest is equivalent to the added cost of buying on instalments?

If i = \$4, p = \$288, and $t = \frac{1}{12}$, show that $r = 16\frac{2}{3}\%$.

3. Find the interest rate equivalent to the added instalment cost of buying each article listed on page 110.



Cuk No.
ACCEPTED
PAYABLE AT THE
HANOVER NATIONAL BANK
CLEARING
UNION TRUST CO.

Dillon, Read & Co.
New York May 1st 1925

PAID
MAY 1-25
C.U.T.CO.N.Y

Pay to Dodge Brothers $146.000.000.xx
477 One hundred forty Six Million Dollars

TO CENTRAL UNION TRUST COMPANY
1-191 OF NEW YORK

Dillon Read & Co

Fig. A. Largest sum ever paid by cheque to settle a business transaction.

CHEQUES—BIG AND LITTLE

John bought a cookie. He paid **cash,** one cent, for it. His mother bought clothing for the family. She paid the department store bill monthly **by cheque.** These are two common examples of **business transactions.** Money, or the promise to pay money, was given in each instance; but the amount paid by cheque was far greater than that paid by cash. Indeed, 92–95% of all money which changes hands in business, is by cheque.

1. Suppose that sales of goods or services in your community during one week amounted to $5,000,000. About how much would be paid in cash? by cheque?

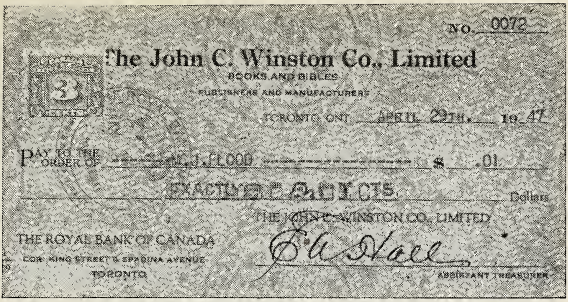
2. An American family, engaged in the manufacture of automobiles, decided to sell its business. A purchaser was found at $146,000,000 (Fig. A). This was the largest sum ever paid by cheque to settle a business transaction.

a. Who was the **payee** (party to whom money is to be paid) of the cheque?

b. Who was the **maker** (party who must pay the money) of the cheque?

c. On what bank was the cheque drawn?

d. When was it drawn? *e*. Where was it drawn?



No. 0072

The John C. Winston Co., Limited
BOOKS AND BIBLES
PUBLISHERS AND MANUFACTURERS

TORONTO, ONT. APRIL 29TH, 1947

PAY TO THE ORDER OF L. J. FLOOD $ .01

EXACTLY [illegible] CTS. Dollars

THE ROYAL BANK OF CANADA
COR. KING STREET & SPADINA AVENUE
TORONTO

THE JOHN C. WINSTON CO. LIMITED

ASSISTANT TREASURER

Fig. A. One of the smallest amounts ever paid by cheque.

f. What writing must appear on the back of this cheque before it can be cashed or deposited?

g. Who must sign this writing?

3. Figure 113-A represents one of the smallest amounts ever paid by cheque. Apply each question (problem **2**) to this cheque.

4. Copy from the cheques:

a. The amount **written** in figures; **written** in words

b. The amount **typewritten**

c. The amount **printed** by a cheque-writing machine.

5. Our Government at Ottawa pays its bills, as does any citizen, and usually by cheque. Each bill must be O.K.'d as correct, blank cheques must be printed, filled in properly, and signed. Cancelled cheques must be filed. All this costs 21¢, on the average, for each cheque issued.

If the Government issues about 1,500,000 family allowance cheques per month, what is the annual cost of issuing such cheques?

6. A bank had $9,500,000 in deposits, 15% of which it kept on hand.

a. If you were a bank examiner, about how much money would you find in this bank at any given time?

b. About how much of the depositors' money would be elsewhere?

⋆SERVICE CHARGES

Banks, as well as the Canadian Government (page 113), are put to heavy expense in handling cheques. Deposit slips, cheque books, and other forms are supplied to depositors. Records are kept of deposits and withdrawals. These, and other like expenses, may be met by a **service charge** for carrying accounts against which cheques are written.

Service charges differ among banks. Here is one method:

Depositors may draw monthly without charge

5 cheques on minimum monthly balances up to $100
10 cheques on minimum monthly balances, $100.01–$300
15 cheques on minimum monthly balances, $300.01–$400
20 cheques on minimum monthly balances, $400.01–$500
Unlimited cheques on minimum balances over $500

Depositors will pay

5¢ for each cheque drawn above the free allowance

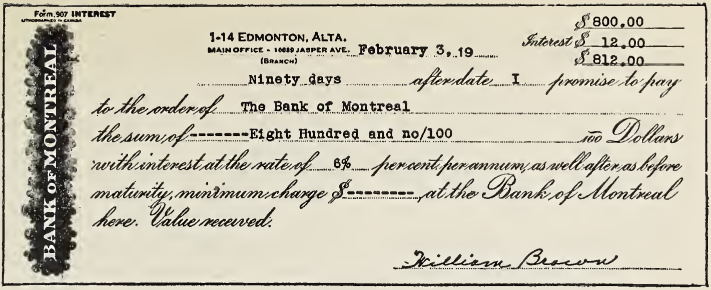
1. Mr. White's minimum balance for August was $250. He drew 12 cheques during the month. What was the service charge?

2. During the same month Mr. Snowden's minimum balance was only $125. He also drew 12 cheques. What service charge did Mr. Snowden pay?

3. Find the service charge for each of the following:

	Minimum Balance	No. of Cheques		Minimum Balance	No. of Cheques
a.	$320	18	*d.*	$210	15
b.	$100	5	*e.*	$190	14
c.	$600	20	*f.*	$480	23

⋆4. What service charges, if any, would Mr. White and Mr. Snowden have paid if they were depositors in your nearest bank?



Form 907 INTEREST
LITHOGRAPHED IN CANADA

BANK OF MONTREAL

$800.00
1-14 EDMONTON, ALTA.
MAIN OFFICE - 10089 JASPER AVE. February 3, 19
(BRANCH)
Interest $ 12.00
$812.00

Ninety days after date I promise to pay to the order of The Bank of Montreal the sum of -------Eight Hundred and no/100 100 Dollars with interest at the rate of 6% per cent per annum, as well after as before maturity, minimum charge $-------- at the Bank of Montreal here. Value received.

William Brown

PROMISSORY NOTES

Borrowing money from a bank. Mr. Brown borrows $800 from the bank in order to pay cash for his merchandise. He expects to sell the goods at a profit within 90 days, so he borrows this money for that period at 6%. He gives the bank a note for $800. The note is due on May 4, but in Canada Mr. Brown is allowed 3 additional days, called **days of grace,** in which to pay. These extra 3 days make the note legally due on May 7. Interest must be paid on these 3 extra days.

The date in the upper right-hand corner is the date when the note was written. This is called the **date of the note.** The day on which the note is due is called the **date of maturity.** Mr. Brown is the **maker** of the note. The sum of $800 written on the note is called **the face of the note.** The Royal Bank of Canada, to which the money is to be paid, is called the **payee.**

How interest on a note is computed. For how many days did the bank lend the $800 to Mr. Brown?

Think: Feb. 3 to Feb. 28 = 25 days
Feb. 28 to Mar. 31 = 31 days
Mar. 31 to Apr. 30 = 30 days
Apr. 30 to May 7 = 7 days
The bank charged interest for 93 days. 93 days

To find the interest paid by Mr. Brown, use the formula:

$$i = prt$$

What does each letter in the formula represent?

To find the interest on \$800 for 90 days at 6% proceed as follows:

When a loan is made for a certain number of days, the interest is calculated on 365 days, sometimes 366 days, in a year.

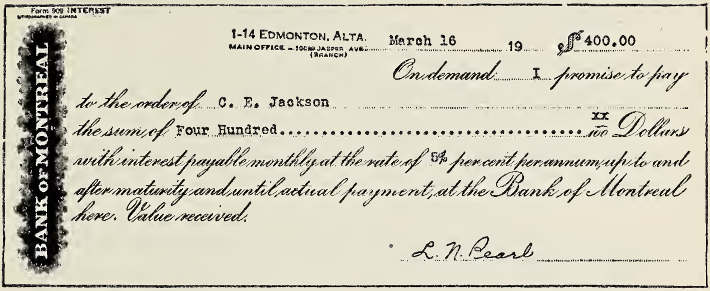
$$i = 800 \times \frac{6}{100} \times \frac{93}{365} = \$12.23$$

Find the interest on the following bank loans:

Principal	Time	Rate	Principal	Time	Rate
1. \$250	30 da.	6%	**11.** \$2,500	27 da.	4%
2. \$730	30 da.	6%	**12.** \$3,250	60 da.	4%
3. \$675	60 da.	4%	**13.** \$1,650	15 da.	6%
4. \$485	90 da.	5%	**14.** \$1,275	83 da.	6%
5. \$325	60 da.	4%	**15.** \$1,845	64 da.	5%
6. \$180	90 da.	5%	**16.** \$2,200	70 da.	5%
7. \$545	45 da.	6%	**17.** \$2,750	40 da.	6%
8. \$860	75 da.	6%	**18.** \$1,956	18 da.	7%
9. \$935	36 da.	7%	**19.** \$3,500	48 da.	4%
10. \$748	72 da.	5%	**20.** \$2,375	88 da.	5%

21. Write a note payable at the Bank of Montreal, using the items mentioned in the first problem.

Who is the maker? What is the face of the note? What is the date of maturity? What amount must the maker pay on the date of maturity?



Form 909 INTEREST
LITHOGRAPHED IN CANADA

BANK OF MONTREAL

1-14 EDMONTON, ALTA. March 16 19 $400.00
MAIN OFFICE – 10089 JASPER AVE. (BRANCH)

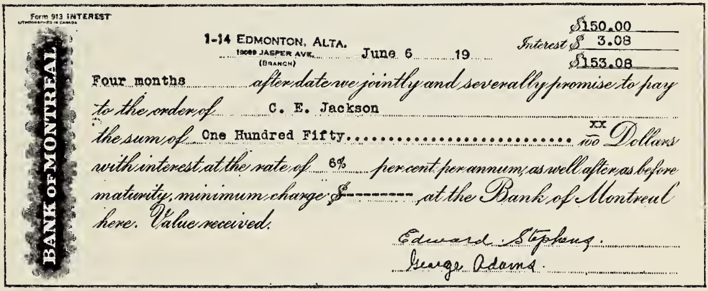
On demand I *promise to pay*
to the order of C. E. Jackson
the sum of Four Hundred xx/100 *Dollars*
with interest payable monthly at the rate of 5% *per cent per annum, up to and after maturity and until actual payment, at the Bank of Montreal here. Value received.*

L. N. Pearl

Kinds of promissory notes. This section will teach you some important facts about promissory notes that everyone should know.

1. There are several kinds of promissory notes. The following notes illustrate some of the various kinds.

Above is a **demand note.** Why do you think it is so called?



Form 913 INTEREST
LITHOGRAPHED IN CANADA

BANK OF MONTREAL

1-14 EDMONTON, ALTA. June 6 19
10089 JASPER AVE. (BRANCH)

$150.00
Interest $ 3.08
$153.08

Four months *after date we jointly and severally promise to pay*
to the order of C. E. Jackson
the sum of One Hundred Fifty xx/100 *Dollars*
with interest at the rate of 6% *per cent per annum, as well after as before maturity, minimum charge* $-------- *at the Bank of Montreal here. Value received.*

Edward Stephens.
George Adams.

In what ways does this note differ from the first one? This is called a **time note.** Why?

The note at the bottom of page 117 is also called a joint note. Why? Notice that the note reads "we jointly and severally promise . . ." What do you suppose these words mean?

2. In what respects are these three notes alike? In what respects do they differ?

3. Who were the makers of the notes on pages 115 and 117?

4. The party whom the maker promises to pay is called the **payee** of the note. Who were the payees of the notes?

5. A note in which the maker promises to pay the principal with interest is called an **interest-bearing** note. A note in which the maker promises to pay the principal only is called a **non-interest-bearing** note. Are all of the notes shown here interest-bearing?

6. Sometimes notes are so written that they can be paid only to the person named in the note, while others are so drawn up that they can be paid to other people and are therefore **negotiable.** A note is negotiable if it is payable to the order of the payee, or to bearer.

Are the notes on pages 115 and 117 negotiable?

7. The words "value received" on the notes show that the maker received money or something else of value.

8. Draw up a negotiable, interest-bearing note for $400 payable in 60 days. Be sure to write "specimen" or "sample" across the note. Why?

HOW TO FIND THE DATE ON WHICH A NOTE MATURES

1. On July 15, Harry borrowed $100 from his father to complete his farm-club project. His father knew that Harry's corn field would yield a large crop. Harry gave his father a promissory note for 90 days at 6% interest.

How much did Harry pay his father on the date of maturity? On what date was the money legally due?

To find the date of maturity proceed as follows:

16 da. left in July
31 da. in August
30 da. in September
16 da. in October
93 da., the time of the note.

Count from the date of the note until the number of days stated in the note, plus 3, has been counted.

The legal date of maturity of Harry's note was Oct. 16.

2. If the note had been for 3 months, the date of maturity would be found by counting forward 3 months from the date of the note and then adding 3 days. Why? The date of maturity would have been October 19.

3. Find the legal date of maturity of the following:

	Date of Note	Time		Date of Note	Time
a.	Aug. 12, 1940	60 da.	*c.*	Jan. 1, 1941	3 mo.
b.	Oct. 14, 1941	90 da.	*d.*	Jan. 1, 1942	90 da.

4. On January 12, 1945, Mr. Smith wished to find how many days remained before the date of maturity of a 60-day note, dated December 15, 1944. How many days were left?

5. On April 1, 1944, Mr. Aird wished to find the number of days to the date of maturity that remained on a 3-month note, date March 4, 1944. How many days were left?

⋆TRY THESE

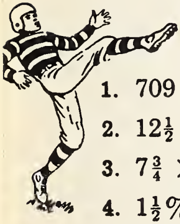
1. On May 1 Mr. Fox signed a demand note for $500 at 6%. He paid off the note March 1 following. Interest payments were due every 90 days. What were the regular interest dates, and how much was due on each date? How many days were there between the last regular interest payment and the date the loan was paid?

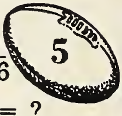
2. A demand note, dated September 1, is paid off the following September 1. If the interest was due every 90 days, what were the dates for interest payment?

3. In some years there are exactly 100 days from Easter to the First of July. As Easter always comes on Sunday, on what day of the week will the First of July come in such a year?

4. In some years there are exactly 64 days from the First of July to Labour Day. As Labour Day always falls on Monday, on what day will the First of July fall in such a year?

LET'S PRACTISE





	a	*b*	*c*
1.	$709 \times 806 = ?$	$15\frac{3}{4} - 9\frac{7}{8} = ?$	$365\overline{)17486}$
2.	$12\frac{1}{2} \div 3\frac{1}{5} = ?$	$4.6 \times 4.6 = ?$	$9 \div .16 = ?$
3.	$7\frac{3}{4} \times 9\frac{1}{2} = ?$	$38 - 15\frac{3}{8} = ?$	$6\frac{3}{4} \times 85 = ?$
4.	$1\frac{1}{2}\%$ of $960 = ?$	102.5% of $1250 = ?$	$36 = ?\%$ of 54
5.	$120 = ?\%$ of 80	$15 = ?\%$ of 50	$\frac{3}{4}\%$ of $200 = ?$

6. To the nearest hundredth, find the decimal value of: *a.* $\frac{6}{7}$; *b.* $\frac{7}{12}$; *c.* $\frac{11}{16}$; *d.* $\frac{3}{8}$; *e.* $\frac{2}{3}$; *f.* $\frac{5}{6}$.

USING THE VOCABULARY OF ARITHMETIC

Use correctly in a sentence or give the meaning of each of the following terms. If you do not know the meaning of any term, refer to the key page in parentheses.

amount	(106)	interest formula	(106)
days of grace	(115)	maker of a note	(115)
date of maturity	(115)	negotiable note	(118)
demand note	(117)	payee of a note	(115)
face of note	(115)	promissory note	(115)
interest table	(107)	rate of interest	(108)
instalment buying	(109)	time note	(117)

*TOPICS FOR SPECIAL REPORTS

1. What is a "clearing house"? Show how cheques are handled through the clearing house.

2. How are each of the following used: *a.* a cashier's check? *b.* a letter of credit? *c.* a bank draft?

3. State four ways by which money may be transferred safely from one person to another. Under what conditions would each form be used?

4. Find advertisements which give the cash price and the instalment price of several articles. Compute the interest rate equivalent to the added cost of buying on time.

5. What are "small-loan companies"? What rate of interest is charged by those companies which may serve your community?

6. Make a table from which the number of days between any two dates within a year may be found.

7. For what reasons may a bank refuse to lend money?

HOW WELL DO YOU REMEMBER?

1. What does each letter represent in the interest formula, $i = prt$?

2. Using the interest formula, find i when $p = \$750$, $r = 3\%$, and $t = 60$ days; when $p = \$450$, $r = 5\frac{1}{2}\%$, and $t = \frac{1}{2}$ year.

3. What is the difference between:
   - *a.* A negotiable and a non-negotiable note?
   - *b.* A demand note and a time note?

4. Find the rate when the interest on $750 for 6 months is $11.25.

5. Using the interest table on page 107, find the interest on $545 at 6% per annum for 93 days.

6. On May 1st Mr. Wharton secured from his bank a $730 loan at 6% per annum. He gave the bank a 90-day note.
   - *a.* What was the date of maturity of the note?
   - *b.* What amount was due the bank on the date of maturity?

7. A demand note for $450, bearing interest at 5% and dated June 15, was paid on September 25. What amount was required to redeem the note on the latter date?

*8. What are some of the services rendered by banks?

*9. A vacuum cleaner sells for $60 cash, or $10 down and $6 a month for 9 months. What is the interest charge for buying on instalments in this case?

*10. Give some of the advantages of instalment buying; some disadvantages.

THINGS TO REMEMBER

1. *How to find simple interest.*

2. *How to use the interest formula.*

3. *How promissory notes are used.*

★4. *What instalment buying is, and some reasons why goods usually cost more on instalments than for cash.*

TEST ON CHAPTER V

1. Find the interest on $350 for 75 days at 6%.

   a. Using the interest formula.

   b. Using the interest table.

2. How many days are there from June 30 to October 15?

3. Find the dates of maturity of the following notes:

Date of Note	Time
a. July 7	60 days
b. Nov. 8	3 months
c. May 24	90 days
d. Mar. 5	6 months

4. Find the value at maturity of a 60-day note for $600 bearing interest at 4%.

★5. State three reasons why the cost of an article purchased on the instalment plan is more than the cash price.

★6. A used car may be bought for $325 cash or $135 down and $19.84 a month for 12 months. Find the difference between the cash and the instalment prices.

PROGRESS TEST

Solve the problems and perform the indicated operations. If you make errors on this test, turn to the key pages in parentheses where the work is explained.

1. 408 × 809 = ? (9)
2. 9129 ÷ 16 = ? (13)
3. 3% of $150 = ? (65)
4. 12 = ? % of 72 (66)
5. .27 × 76.9 = ? (21)
6. $\frac{1}{2}$% of 40 = ? (72)
7. 100 = ? % of 1000 (66)
8. 6000 − 4008 = ? (8)
9. 50 = 25% of ? (74)
10. .676 ÷ 26 = ? (23)

11. From the sum of $9\frac{1}{8}$ and $3\frac{1}{2}$ subtract $6\frac{3}{4}$. (15)

12. Find the least common denominator of fractions having denominators of 2, 3, 4, 6, and 8. (15)

13. Express as decimals: *a.* 3%; *b.* $\frac{1}{2}$%; *c.* 120%; *d.* 20%; *e.* 102%; *f.* 3.5%. (59)

14. Find the sum of: 9.6, 1.8, 0.7, 3.5, 7.4, and 11.6. (20)

15. Draw and name three different kinds of triangles classified according to their angles (43)

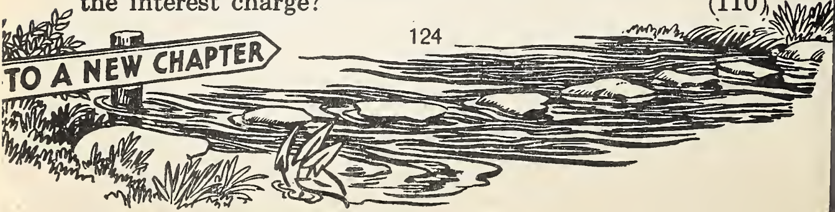
16. What is the difference between a parallelogram and a trapezoid? Draw each. (46)

17. Mr. Jones sold a car for $765 and received a commission of 24%. What was his commission? (65)

18. A news report showed that the number of deaths due to automobile accidents last month was only 80% as many as for the same month last year. If 120 persons were killed last month, how many were killed in the same month last year? (74)

19. Find the value at maturity of a 60-day note for $300 bearing interest at 5%. (115)

★20. A refrigerator was advertised for $180 cash, or $8 down and $8 a month for 24 months. What was the interest charge? (110)



CHAPTER VI

SAVING AND INVESTING MONEY

1. In an arithmetic class at the Mountglen School it was discovered that 20 pupils had savings accounts while 15 had none. This led to a class discussion on how to save money and to invest it. Out of the discussion came the following plan which each pupil agreed he could follow as soon as he was working and earning.

I will: Open a savings account
Insure my life
Buy bonds
Own my home
Buy stock

In this chapter you will learn about four items in the plan. Life insurance will be studied in Chapter VII.

2. Mary knew that savings accounts could be opened at banks, but she wanted to know whether such accounts could be established in other institutions. She consulted the Canada Year Book and found the following information:

a. Savings accounts can be opened with chartered banks, and with many trust and loan companies.

b. The Post Office Savings Bank is operated by the Dominion Government for the special benefit of those who wish to open savings accounts.

c. In Alberta and Ontario there are savings banks operated by the provincial governments.

d. In most provinces there are Co-operative Credit Unions which encourage regular saving of amounts too small to be deposited elsewhere.

★3. Secure additional information about the institutions mentioned above, that would be most useful to you if you wished to open a savings account.

BILL'S SAVINGS ACCOUNT

Date		Particulars	Initials	Withdrawals		Deposits		Balance	
19 June	41 1		M			$10	00	$10	00 ✓
July	3		M			5	50	15	50
Aug	5		L			6	50	22	00
Sept	4		M			9	00	31	00
Oct	15		M	$11	00			20	00 ✓
Nov	3		A			5	00	25	00
Nov	30	Interest	L				11	25	11
Dec	5		M			7	00		?
19 Jan	42 12		M	5	00				?
Feb	3		A			6	50		?
Mar	5		M			5	00		?
Apr	9		L			4	60		?
May	5		L	5	00				?
May	31	Interest	L				?		?

On June 1 Bill Smith opened a savings account at the bank in his town. This is a copy of a page from Bill's passbook, showing deposits during the year, money withdrawn, interest, and his balance.

The bank paid Bill interest on his savings at the rate of 1½% a year. Interest was computed on November 30, and May 31 each year on the **minimum quarterly balance.** The minimum quarterly balance was the smallest balance Bill had on deposit during each successive three months beginning with the month of June. The first interest period for Bill's account was from June 1 to November 30. The following procedure will help you to find the approximate interest on his savings at 1½%.

NOTE: At 1½%, 1½¢ is the interest on $1.00 for 12 months. Then, ⅜ cents is the interest on $1.00 for 3 months, or 1 quarter, *a.* Make a check mark (√) opposite each minimum quarterly balance in the passbook. (This has already been done for the two quarters of the first interest period.)

b. Multiply the number of whole dollars in the minimum balance by $\frac{3}{8}$ and express the answer as cents.

c. Do this for each quarter and add to find the semiannual interest.

1. After interest was credited, November 30, what was the amount of his balance?

2. Find the missing balances up to May 31, 1942.

3. On what sums does Bill draw interest during the second interest period? Interest is paid on dollars only; cents are not considered.

4. Find the amount of interest Bill will be paid on May 31. What was his balance after interest had been credited on May 31?

5. If Bill makes no further deposits or withdrawals during the six months following May 31, what will his balance be on November 30, 1942?

6. H. R. Masters' savings account showed the following deposits: January 1, 1935, \$140.75; February 5, \$65.60; April 4, \$35; Sept. 3, \$52.50; March 6, 1936, \$57.75. On June 15, 1935, he drew out \$40; January 2, 1936, \$20. If he is allowed interest on the minimum quarterly balances at the rate of $1\frac{1}{2}\%$ per annum, on May 31 and November 30, how much interest should Mr. Masters receive to his credit on May 31, 1935? On November 30, 1936? How much is his balance on that date? Tabulate these data in columns headed, Date, Deposits, Interest, Withdrawals, Balance.

HOW BANKS EARN MONEY

Banks do an extensive business in lending money. On each loan, interest is charged. The rate of interest depends upon the size of the loan, and the nature of business of the borrower.

1. Mr. Business Man drops in for a loan. "About $500 will be enough," says he, "and how much will it cost?" "6%," replies the banker, "and interest payable every 3 months." How much interest does Mr. Business Man pay at the end of each period? (HINT: Interest rates are based on a year unless otherwise stated.)

2. The local street railway needs some new streamlined cars and busses. It borrows $250,000 at 4% from the bank.

a. How much interest must the trolley company pay every 6 months?

b. If the loan must be repaid at the end of 10 years, how much will the borrowing cost the company? (HINT: Interest plus principal.)

c. How much will the loan have earned for the bank?

3. The Dominion Government borrows 2 million dollars from the bank and gives its written promise to pay in 20 years with interest at 2% a year. This is a **bond**.

a. How much does the loan earn for the bank?

b. How much does it cost the Government?

4. Miss Depositor likes to pay her bills by cheque but is unable to keep very much money on deposit. So the bank makes a charge of $1 a month for her account plus 5¢ for each cheque she draws. If Miss Depositor draws 25 cheques a year, how much does her account earn for the bank?

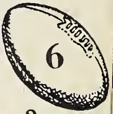
*5. Find out from a bank what traveller's cheques are, how they are used, and what the bank charges for them.

THE POST OFFICE SAVINGS BANK

Any person may deposit money in the Post Office Savings Bank. According to regulations, the total deposits of each year must not exceed $1,500, and the maximum balance, not including interest, at the credit of any such account is limited to $5,000.

A depositor in any of the Savings Bank Post Offices may continue his deposits at any other convenient Savings Bank Post Office, or withdraw his money at them. Each depositor is supplied with a passbook, which must be produced when money is deposited or withdrawn. Each depositor's account is kept in the Postmaster General's office in Ottawa, which makes a direct acknowledgment of each deposit. Each depositor must send his book once a year for insertion of interest and comparison with the books of the department. In a recent year there were deposits amounting to $28,000,000. There is no charge for paying in or drawing out funds at these banks.

Interest at the rate of 2% is added to the principal on March 31 in each year.



LET'S PRACTISE PER CENTS

	a	*b.*	*c.*
1.	12% of 45 = ?	2% of 730 = ?	$\frac{1}{2}$% of 650 = ?
2.	106% of 850 = ?	140% of 68 = ?	2$\frac{1}{2}$% of 1000 = ?
3.	14 = ? % of 70	75 = ? % of 60	1 = ? % of 200
4.	90 = ? % of 15	15 = ? % of 90	100 = ? % of 75
*5.	15 = 10% of ?	50 = 2% of ?	75 = 25% of ?

6. Write as per cents: *a.* $\frac{3}{4}$; *b.* 5; *c.* .9; *d.* 1.7.

7. Write as decimals: *a.* 4%; *b.* 2$\frac{1}{2}$%; *c.* 101%; *d.* 10%.

8. Round off the following to the nearest whole per cent: *a.* 34.45%; *b.* 6.5%; *c.* 12.75%; *d.* 26.495%.

HOW SAVINGS GROW

1. Jane Brooks had quite a surprise on her 17th birthday. Her father gave her a present of $200. Mr. Brooks invested $100 at 4% when Jane was born. How long did it take the money to **double itself** ($1 to become $2)?

2. If Jane reinvested her $200 at 4%, how old will she be before it amounts to $400?

3. For many years in Canada, people with money to lend could get 6% interest. At this rate money doubles itself in about 12 years. Suppose a child at birth received a gift of $50 and the money was put out at 6%. How much will he have if he lives to age 48?

4. The interest rate at the Reliance Trust Company was 2%, payable semi-annually. If Mr. Lance deposited $100 in the Trust Company (and withdrew nothing), how much would he have at the end of 2 years?

$100.00	**original principal**
1.00	**int. for 6 mo.**
$101.00	**principal after 6 mo.**
1.01	**int. for 6 mo.**
$102.01	**principal after 1 yr.**
1.02	**int. for 6 mo.**
$103.03	**principal after 1½ yr.**
1.03	**int. for 6 mo.**
$104.06	**principal after 2 yr.**

a. What was his original principal?

b. How much interest did it earn in 6 months? (This is simple interest.)

c. How much was on deposit at beginning of second 6-month period? (This is the **amount**—principal plus interest.)

d. How much interest was earned during the second 6-month period? How much more was this than the interest for the first period? (This excess is **compound interest**—interest on interest.)

e. What is the simple interest at the end of the 2nd year? the compound interest? the amount?

f. Why was the interest for each period computed at 1% when the trust company rate was 2%?

5. If the interest rate is 3%, what is the semiannual rate? the quarterly rate?

6. At the end of one year $100 at 4%, compounded quarterly, is how much more or less than $100 at 4% compounded semiannually?

7. If $500 at 4% is compounded quarterly, the compound interest for one year is how much greater than simple interest for the same time and rate?

8. If the interest is compounded yearly, find the compound interest on

a. $100 at 3% for 3 yr.	*c.* $500 at 4% for 2 yr.
b. $100 at 4% for 3 yr.	*d.* $600 at 2% for 3 yr.

9. The compound interest (examples *a* to *d*) is how much more than simple interest?

***10.** In 1626 the Dutch bought the island of Manhattan (now part of New York City) for about $24. Suppose the purchase price had been put at 6% simple interest until 1926 (300 years), how much would it have earned?

***11.** Suppose the purchase price had been compounded annually at 6% for 300 years, what would have been the amount in 1926? This problem would take so long to solve that we give you the answer: $942,069,324. The compound interest is about how many times the simple interest?

***12.** Using *p* for principal, *i* for interest, and *a* for amount, write the formula for *a*.

*TABLE FOR COMPOUND INTEREST

1. The method that you have been using previously to compute compound interest was introduced to acquaint you with the full meaning of the process. Now we will turn to a table that is similar to those that the banks use. We will have use for only a part of the table, however. It must be understood that the table is constructed on the basis of a principal of $1.00 and that *n* stands for the number of interest periods.

Why do you think that seven-place decimals are used?

n	½%	1%	1½%	2%	2½%	3%
1	1.005 0000	1.010 0000	1.015 0000	1.020 0000	1.025 0000	1.030 0000
2	1.010 0250	1.020 1000	1.030 2250	1.040 4000	1.050 6250	1.060 9000
3	1.015 0751	1 030 3010	1.045 6748	1.061 2080	1.076 8906	1.092 7270
4	1.020 1505	1.040 6040	1.061 3636	1.082 4322	1.103 8129	1.125 5088
5	1.025 2513	1.051 0101	1.077 2840	1.104 0808	1.131 4082	1.159 2741
6	1.030 3775	1.061 5202	1 093 4433	1.126 1624	1.159 6934	1.194 0523
7	1.035 5294	1.072 1354	1.109 8449	1.148 6857	1.188 6858	1.229 8739
8	1.040 7070	1.082 8567	1 126 4926	1.171 6594	1.218 4029	1.266 7701
9	1.045 9106	1.093 6853	1 143 3900	1.195 0926	1.248 8630	1.304 7732
10	1.051 1401	1.104 6221	1.160 5408	1.218 9944	1.280 0845	1.343 9164
11	1.056 3958	1.115 6683	1.177 9489	1.243 3743	1.312 0867	1.384 2339
12	1.061 6778	1.126 8250	1.195 6182	1.268 2418	1.344 8888	1.425 7609
13	1.066 9862	1.138 0933	1.213 5524	1.293 6066	1.378 5110	1.468 5337
14	1.072 3211	1.149 4742	1.231 7557	1.319 4788	1.412 9738	1.512 5897
15	1.077 6827	1.160 9690	1.250 2321	1.345 8683	1.448 2982	1.557 9674
16	1.083 0712	1.172 5786	1.268 9855	1.372 7857	1.484 5056	1.604 7064
17	1.088 4865	1.184 3044	1.288 0203	1.400 2414	1.521 6183	1.652 8476
18	1.093 9289	1.196 1475	1.307 3406	1.428 2462	1.559 6587	1.702 4331
19	1.099 3986	1.208 1090	1.326 9507	1.456 8112	1.598 6502	1.753 5061
20	1.104 8956	1.220 1900	1.346 8550	1.485 9474	1.638 6164	1.806 1112
21	1.110 4201	1.232 3919	1.367 0578	1.515 6663	1.679 5819	1.860 2946
22	1.115 9722	1.244 7159	1.387 5637	1.545 9797	1.721 5714	1.916 1034
23	1.121 5520	1.257 1630	1.408 3772	1.576 8993	1.764 6107	1.973 5865
24	1.127 1598	1.269 7346	1.429 5028	1.608 4372	1.808 7259	2.032 7941
25	1.132 7956	1.282 4320	1.450 9454	1.640 6060	1.853 9441	2.093 7779
26	1.138 4596	1.295 2563	1.472 7095	1.673 4181	1.900 2927	2.156 5913
27	1.144 1519	1.308 2089	1.494 8002	1.706 8865	1.947 8000	2.221 2890
28	1.149 8726	1.321 2909	1.517 2222	1.741 0242	1.996 4950	2.287 9277
29	1.155 6220	1.334 5039	1.539 9805	1.775 8447	2.046 4074	2.356 5655
30	1.161 4001	1.347 8489	1.563 0802	1.811 3616	2.097 5676	2.427 2625

2. In using the table, suppose we wish to find the interest on \$500, compounded annually for six years at 5%. The column headed 5% contains the amount of \$1.00 for one to thirty years. Run your finger down column *n* to the sixth line, then over until you come to column headed 5%. You will find the amount there is \$1.34 (rounded to two decimal places), which represents 34¢ interest plus the \$1.00 principal. In order to compute the interest on \$500, we would multiply the 34¢, interest on \$1.00, by 500.

$$500 \times .34 = \$170$$

n	3½%	4%	4½%	5%	5½%	6%
1	1.035 0000	1.040 0000	1.045 0000	1.050 0000	1.055 0000	1.060 0000
2	1.071 2250	1.081 6000	1.092 0250	1.102 5000	1.113 0250	1.123 6000
3	1.108 7179	1.124 8640	1.141 1661	1.157 6250	1.174 2414	1.191 0160
4	1.147 5230	1.169 8586	1.912 5186	1.215 5063	1.238 8247	1.262 4770
5	1.187 6863	1.216 6529	1.246 1819	1.276 2816	1.306 9600	1.338 2256
6	1.229 2553	1.265 3190	1.302 2601	1.340 0956	1.378 8428	1.418 5191
7	1.272 2793	1.315 9318	1.360 8618	1.407 1004	1.454 6792	1.503 6303
8	1.316 8090	1.368 5691	1.422 1006	1.477 4554	1.534 6865	1.593 8481
9	1.362 8974	1.423 3118	1.486 0951	1.551 3282	1.619 0943	1.689 4790
10	1.410 5988	1.480 2443	1.552 9694	1.628 8946	1.708 1445	1.790 8477
11	1.459 9697	1.539 4541	1.622 8530	1.710 3394	1.802 0924	1.898 2986
12	1.511 0687	1.601 0322	1.695 8814	1.795 8563	1.901 2075	2.012 1965
13	1.563 9561	1.665 0735	1.772 1961	1.885 6491	2.005 7739	2.132 9283
14	1.618 6945	1.731 6764	1.851 9449	1.979 9316	2.116 0915	2.260 9040
15	1.675 3488	1.800 9435	1.935 2824	2.078 9282	2.232 4765	2.396 5582
16	1.733 9860	1.872 9812	2.022 3702	2.182 8746	2.355 2627	2.540 3517
17	1.794 6756	1.947 9005	2.113 3768	2.292 0183	2.484 8021	2.692 7728
18	1.857 4892	2.025 8165	2.208 4788	2.406 6192	2.621 4663	2.854 3392
19	1.922 5013	2.106 8492	2.307 8603	2.526 9502	2.765 6469	3.025 5995
20	1.989 7889	2.191 1231	2.411 7140	2.653 2977	2.917 7575	3.207 1355
21	2.059 4315	2.278 7681	2.520 2412	2.785 9626	3.078 2342	3.399 5636
22	2.131 5116	2.369 9188	2.633 6520	2.925 2607	3.247 5370	3.603 5374
23	2.206 1145	2.464 7155	2.752 1663	3.071 5238	3.426 1516	3.819 7497
24	2.283 3285	2.563 3042	2.876 0138	3.225 0999	3.614 5899	4.048 9346
25	2.363 2450	2.665 8363	3.005 4345	3.386 3549	3.813 3923	4.291 8707
26	2.445 9586	2.772 4698	3.140 6790	3.555 6727	4.023 1289	4.549 3830
27	2.531 5671	2.883 3686	3.282 0096	3.733 4562	4.244 4010	4.822 3459
28	2.620 1720	2.998 7033	3.429 7000	3.920 1291	4.477 8431	5.111 6867
29	2.711 8780	3.118 6515	3.584 0365	4.116 1356	4.724 1244	5.418 3879
30	2.806 7937	3.243 3975	3.745 3181	4.321 9424	4.983 9513	5.743 4912

Another method is to find the amount of \$500 (500 × \$1.34 = \$670) by multiplying the amount of \$1.00 by 500 and then subtracting the original principal from this sum.

If we had used the seven-place decimal for the amount of \$1.00, would the result have been different than when rounded to two places? Check.

3. To find interest compounded semi-annually by means of the table, we use the column headed at one half the given rate and the row which represents twice as many interest periods as the number of years. For example:

Find the compound interest on \$300 for 5 years at 6%, compounded semi-annually.

If the rate annually is 6%, the rate each half year is 3%. For a period of 5 years we would have 10 half years, or 10 interest periods. Using the column headed 3% and in the row where *n* is 10, the amount of \$1.00 is \$1.3439, correct to four decimal places. Subtracting the principal, \$1.00 from \$1.3439, we have \$0.3439, the compound interest on \$1.00 for the time and rate given. Multiplying this interest by our principal, we have

$$\$0.3439 \times 300 = \$103.17$$

which is the compound interest on \$500 for 5 years at 6%, compounded semi-annually.

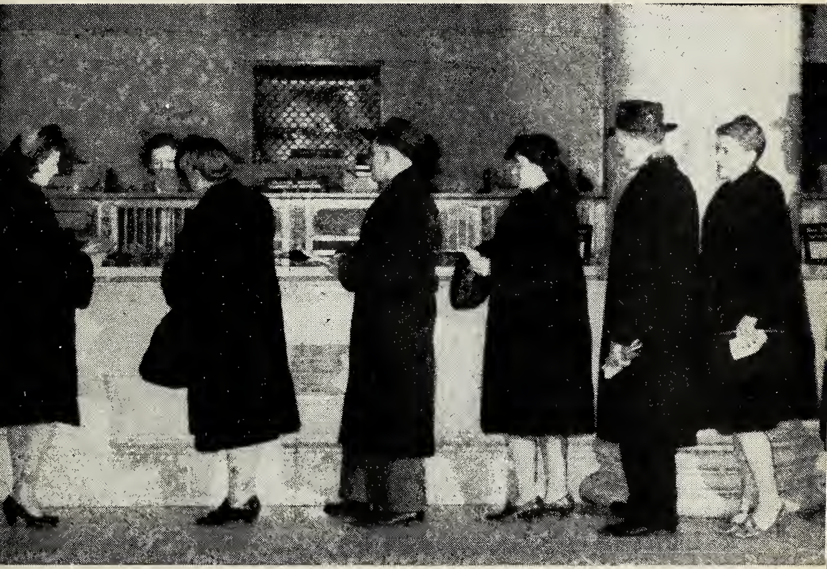
4. Use the seven-place decimal value for \$1.00 in the above computation to determine whether the above amount will be different.

5. How would you find interest that is to be compounded quarterly?

Find the compound amount on the sum of \$1,000, interest compounded every three months at an annual rate of 4% for a period of five years.

6. Use the tables to find the compound interest in the following exercises. (Use four-place decimal values from the tables on pages 132-133).

	PRINCIPAL	RATE	TIME	COMPOUNDED
a.	\$100	4%	6 yr.	Annually
b.	\$400	3%	10 yr.	Annually
c.	\$1,200	4%	6 yr.	Semi-annually
d.	\$500	6%	4 yr.	Quarterly
e.	\$2,000	7%	5 yr.	Semi-annually
f.	\$800	4%	5 yr.	Quarterly
g.	\$1,000	5%	4 yr. 6 mo.	Semi-annually
h.	\$900	6%	3 yr. 6 mo.	Quarterly



OWN YOUR OWN HOME

1. The Clayton family saw a house they liked. Its price, $6000, was $3500 more than they had. What per cent of the price of the house did they have? did they lack?

2. Mr. Clayton discussed the purchase of the house with a loan company. "We will lend you $3500," said the manager, "at 6%, payable semi-annually." How much interest was due each 6 months?

3. "This loan will be for 5 years," continued the manager, "after which the $3500 will be due and payable." What will be the total interest cost on the loan?

4. "May I arrange to pay off something on the loan each year?" asked Mr. Clayton. "Very wise," replied the manager. "Suppose we say 5 equal instalments?" How much was due on each instalment?

5. What was the balance of Mr. Clayton's loan during the second year? The interest due each 6 months?

6. What was the balance for each of the remaining years and the semiannual interest at each due date?

7. Mr. Clayton pledged his new house as security that he would pay interest and instalments when due. Such a written pledge of property for the payment of a debt is a **mortgage.** The amount borrowed is the **principal.** What was the principal of the Clayton mortgage?

MORTGAGE FACTS

1. The Reliance Loan Company lends money on mortgages only up to 60% of the value of the property. If a property is valued at $8,500, how much will the Company lend? How much must the buyer put up?

2. How much would company and buyer each supply if the company loans 50% of the value of the house?

3. A family should not pay more than twice its yearly income for a house in which to live. The Clayton family has an income of $275 a month. How much can it afford to pay for a home?

4. What per cent of the purchase price of the home (problem 3) would a mortgage of $4000 be?

5. A house, mortgaged at $7500, is sold for $7200. What per cent of the mortgage is the sale price?

Who bears the $300 loss—the **mortgagee** (person who lent the money and holds the mortgage) or the **mortgagor** (person who borrowed the money and gave the mortgage)?

6. Find the missing amounts:

	Cost of Property	Mortgage (% of Cost)	Rate of Interest	Yearly Interest
a.	$7500	60%	5%	?
b.	$4800	50%	4½%	?
c.	$3500	40%	4%	?
d.	$5400	55%	6%	?
e.	$4200	35%	3%	?
f.	$6400	60%	5½%	?

7. Find the amounts of the following mortgages:

	Interest	Rate		Interest	Rate		Interest	Rate
a.	$150	5%	*d.*	$120	5%	*g.*	$240	5%
b.	$240	6%	*e.*	$720	4%	*h.*	$180	6%
c.	$ 90	4%	*f.*	$ 90	4½%	*i.*	$ 75	5%

SHALL I RENT OR BUY?

FOR
SALE
$7000.

Mr. Carter, a newcomer to the Clayton-Fields community, was undecided whether to rent or to buy.

1. A house, suited to the Carter family, was vacant and could be bought for $7000. Carter earned $75 a week. Why could Carter afford to buy this house? (Purchase price should not be more than twice the yearly income.)

2. The house could be rented at $65 a month. Why, in your judgment, could Carter afford to rent the house? (Monthly rental should not exceed 25% of income.)

3. Carter decided to buy. He put in $3000 of his money and gave a mortgage at 5% for the remainder. What was the annual interest on the mortgage?

4. If Carter's money had been invested at 3%, how much did he lose when this money went into the house?

5. The Carter property paid taxes, $165, and $16 for insurance against loss by fire. $105 a year went for repairs, and $2\frac{1}{2}$% for **depreciation** (decrease in value through use or other reasons). What was the sum of these charges?

6. What was the total cost a year to Carter for his house? (HINT: Remember interest on Carter's $3000.)

7. How much less did it cost Carter to own his home than to rent at $65 a month? What per cent less?

8. The table shows the income of 6 families and how much each family can afford to pay for a home. The price each can pay is what per cent of its income for 2 years?

	YEARLY INCOME	CAN PAY		YEARLY INCOME	CAN PAY		YEARLY INCOME	CAN PAY
a.	$1800	$3200	*c.*	$3000	$5700	*e.*	$6000	$11,500
b.	$2100	$4000	*d.*	$5000	$9500	*f.*	$8000	$15,000

BUY BONDS

Large companies such as railroads and manufacturers of automobiles, and, indeed, all other kinds and types of businesses, borrow money to start or to expand their business. Political units such as the Dominion Government, the Provinces, the municipalities, cities, and towns also borrow money for various purposes. As security for the money borrowed, these organizations usually issue bonds, such as that shown on page 140.

1. Who is the maker (**organization which issued it**) of the bond on page 140?

2. For what amount (**face**) is the bond written? When was it issued?

3. What rate of interest is promised?

4. How often must the interest be paid? On what dates?

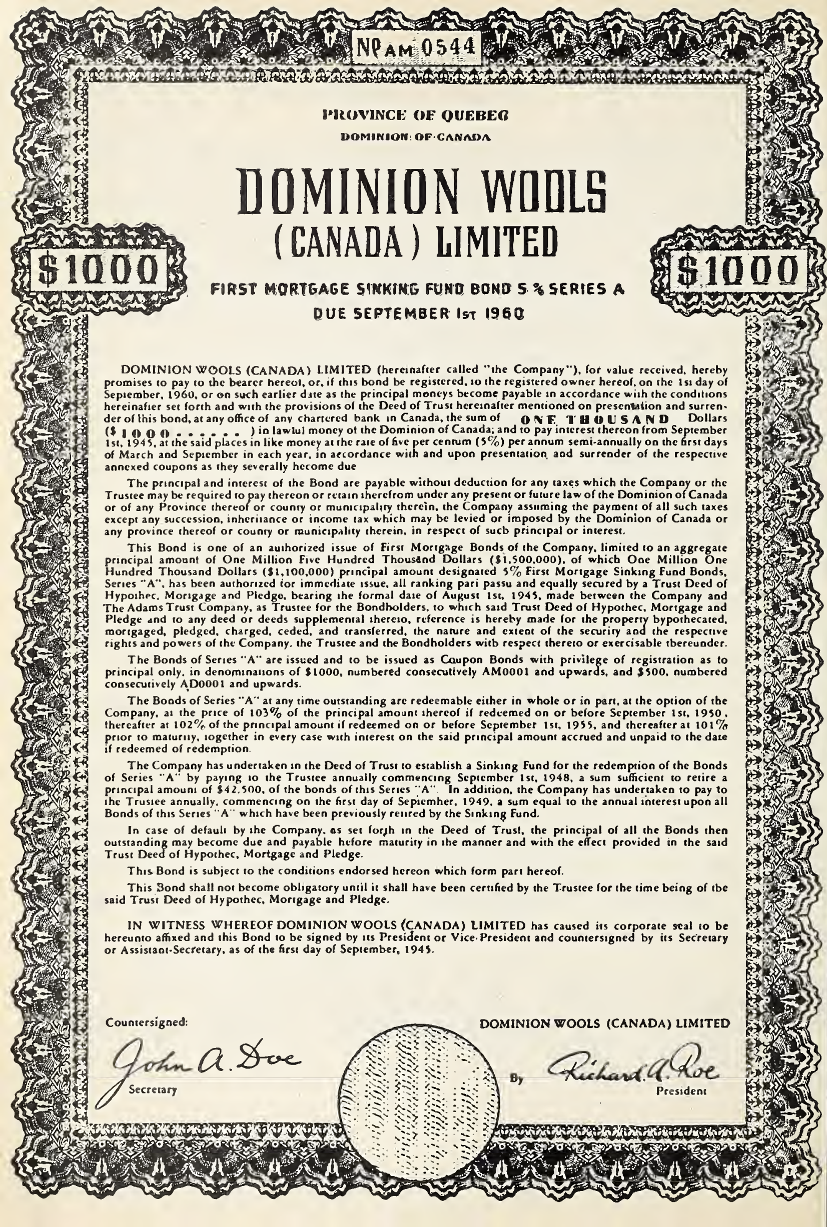
5. To whom (**payee**) must the interest and the face of the bond be paid?

6. When must the face of the bond be paid (date of maturity)?

7. Did the Dominion Wools Co. borrow or lend the $1000?

8. To this bond is attached a page of dated coupons, one of which may be cut off every six months, and **cashed** to secure the interest due. What will be the value of each coupon?

9. Read paragraph 5 to see how the company may **redeem** the bonds. How much would it have to pay for this bond if it decided to redeem it on Sept. 1, 1950? on Sept. 1, 1955?



Nº AM 0544

PROVINCE OF QUEBEC

DOMINION OF CANADA

DOMINION WOOLS
(CANADA) LIMITED

$1000

$1000

FIRST MORTGAGE SINKING FUND BOND 5 % SERIES A
DUE SEPTEMBER 1st 1960

DOMINION WOOLS (CANADA) LIMITED (hereinafter called "the Company"), for value received, hereby promises to pay to the bearer hereof, or, if this bond be registered, to the registered owner hereof, on the 1st day of September, 1960, or on such earlier date as the principal moneys become payable in accordance with the conditions hereinafter set forth and with the provisions of the Deed of Trust hereinafter mentioned on presentation and surrender of this bond, at any office of any chartered bank in Canada, the sum of **ONE THOUSAND** Dollars ($ **1000** - - - - - -) in lawful money of the Dominion of Canada; and to pay interest thereon from September 1st, 1945, at the said places in like money at the rate of five per centum (5%) per annum semi-annually on the first days of March and September in each year, in accordance with and upon presentation and surrender of the respective annexed coupons as they severally become due

The principal and interest of the Bond are payable without deduction for any taxes which the Company or the Trustee may be required to pay thereon or retain therefrom under any present or future law of the Dominion of Canada or of any Province thereof or county or municipality therein, the Company assuming the payment of all such taxes except any succession, inheritance or income tax which may be levied or imposed by the Dominion of Canada or any province thereof or county or municipality therein, in respect of such principal or interest.

This Bond is one of an authorized issue of First Mortgage Bonds of the Company, limited to an aggregate principal amount of One Million Five Hundred Thousand Dollars ($1,500,000), of which One Million One Hundred Thousand Dollars ($1,100,000) principal amount designated 5% First Mortgage Sinking Fund Bonds, Series "A", has been authorized for immediate issue, all ranking pari passu and equally secured by a Trust Deed of Hypothec, Mortgage and Pledge, bearing the formal date of August 1st, 1945, made between the Company and The Adams Trust Company, as Trustee for the Bondholders, to which said Trust Deed of Hypothec, Mortgage and Pledge and to any deed or deeds supplemental thereto, reference is hereby made for the property hypothecated, mortgaged, pledged, charged, ceded, and transferred, the nature and extent of the security and the respective rights and powers of the Company, the Trustee and the Bondholders with respect thereto or exercisable thereunder.

The Bonds of Series "A" are issued and to be issued as Coupon Bonds with privilege of registration as to principal only, in denominations of $1000, numbered consecutively AM0001 and upwards, and $500, numbered consecutively AD0001 and upwards.

The Bonds of Series "A" at any time outstanding are redeemable either in whole or in part, at the option of the Company, at the price of 103% of the principal amount thereof if redeemed on or before September 1st, 1950, thereafter at 102% of the principal amount if redeemed on or before September 1st, 1955, and thereafter at 101% prior to maturity, together in every case with interest on the said principal amount accrued and unpaid to the date if redeemed of redemption.

The Company has undertaken in the Deed of Trust to establish a Sinking Fund for the redemption of the Bonds of Series "A" by paying to the Trustee annually commencing September 1st, 1948, a sum sufficient to retire a principal amount of $42,500, of the bonds of this Series "A". In addition, the Company has undertaken to pay to the Trustee annually, commencing on the first day of September, 1949, a sum equal to the annual interest upon all Bonds of this Series "A" which have been previously retired by the Sinking Fund.

In case of default by the Company, as set forth in the Deed of Trust, the principal of all the Bonds then outstanding may become due and payable before maturity in the manner and with the effect provided in the said Trust Deed of Hypothec, Mortgage and Pledge.

This Bond is subject to the conditions endorsed hereon which form part hereof.

This Bond shall not become obligatory until it shall have been certified by the Trustee for the time being of the said Trust Deed of Hypothec, Mortgage and Pledge.

IN WITNESS WHEREOF DOMINION WOOLS (CANADA) LIMITED has caused its corporate seal to be hereunto affixed and this Bond to be signed by its President or Vice-President and countersigned by its Secretary or Assistant-Secretary, as of the first day of September, 1945.

Countersigned:

John A. Doe
Secretary

DOMINION WOOLS (CANADA) LIMITED

By Richard A. Roe
President

BIG CITY SELLS BONDS

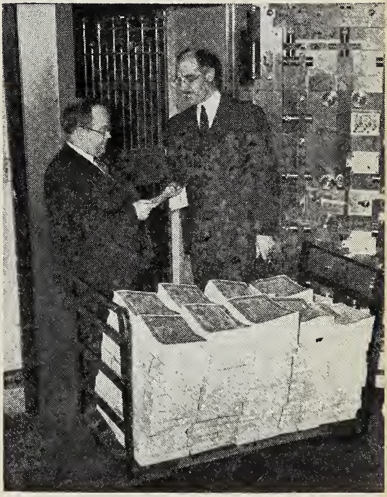
1. "Here is our check for $8,650,000," said the cashier of the bank to the mayor of Big City, "and thanks for the truck load of city bonds." Big City needed new subways and other improvements. The bank had money to lend. Tell how one helped the other.

2. Each Big City bond had a face value of $1000. How many bonds were on the truck?

3. The bonds bore interest at 2.95%. What was the interest on each bond each year?

4. How much interest did Big City pay each year on all these bonds?

5. The bonds mature 30 years from the date issued. How much interest will Big City have paid on these bonds during that time?



★6. Each year Big City took $200,000 of its tax money and invested it so as to have money to pay off the bonds when they came due. Big City put money into its **"sinking fund,"** as we say. How much compound interest must the sinking fund earn? (HINT: Face of bonds less $200,000 a year for 30 years.)

★7. How much more or less did Big City pay as interest on its bonds than the sinking fund earned?

THE LOWELL CANDY COMPANY

After the first of the year and until Easter, James Lowell did a thriving business selling Easter eggs among his friends. Several of his schoolmates wished to join him in the work, so James formed **The Lowell Candy Company.**

He estimated that he would need $15 to keep his enlarged business going until it began to earn. So he sold 150 shares of ownership (called **stock**) at 10¢ a share.

Each pupil who bought one or more shares became a **stockholder** (part owner of the business).

1. If all 150 shares of stock were sold, how much money was received? This amount is known as the **capital** of the company; and the stock, as its **capital stock.**

2. If Stanley owned 5 shares of stock, what per cent of the company did he own?

3. In 2 weeks The Lowell Candy Company had earned $15. The stockholders decided to divide this profit on the basis of 5¢ for each share held. Money earned by a company and divided among the owners (stockholders) is called a **dividend.** If James Lowell held 20 shares, what was his dividend?

4. How much was the total dividend declared?

5. The dividend was what per cent of the capital stock?

6. At the end of the first month of operation a second dividend of 5¢ a share was paid. The 2 dividends were what per cent of the value of the stock?

7. Mary offered James 20¢ a share for half the stock which he owned. How much in all did she offer?

8. At the end of the first month of operation the principal of James' school billed the company $5 for the privilege of selling candy within the school building. *a*. What per cent of the month's earnings of $30 was this charge? *b*. How might it affect the next dividend?

The Lowell Candy Company operated in a small way and with permission only of the school principal. The railroad that serves your neighbourhood, however, has thousands of stockholder-owners, serves many communities, and was granted permission to run trains by the Dominion Government. This right is called a **charter**; and the railroad a **corporation**—that is, a group of people who obtain a charter giving them, as a group, certain rights.

1. Page 144 shows a stock certificate given to each stockholder as a receipt for shares purchased by him.

a. What is the value of this certificate as printed on the **face** (**par value**)?

b. If a stockholder owned 150 shares of the stock, what would its total par value be?

c. Stock certificates may contain any **face** (or **par**) value or none at all (**no par value**). What would be the par value of the stock (problem *b*) if the certificate were marked $5 a share? $10? $25? $50?

2. If a corporation issues 100,000 shares of stock at $10 par value, what is the par value of all of this stock?

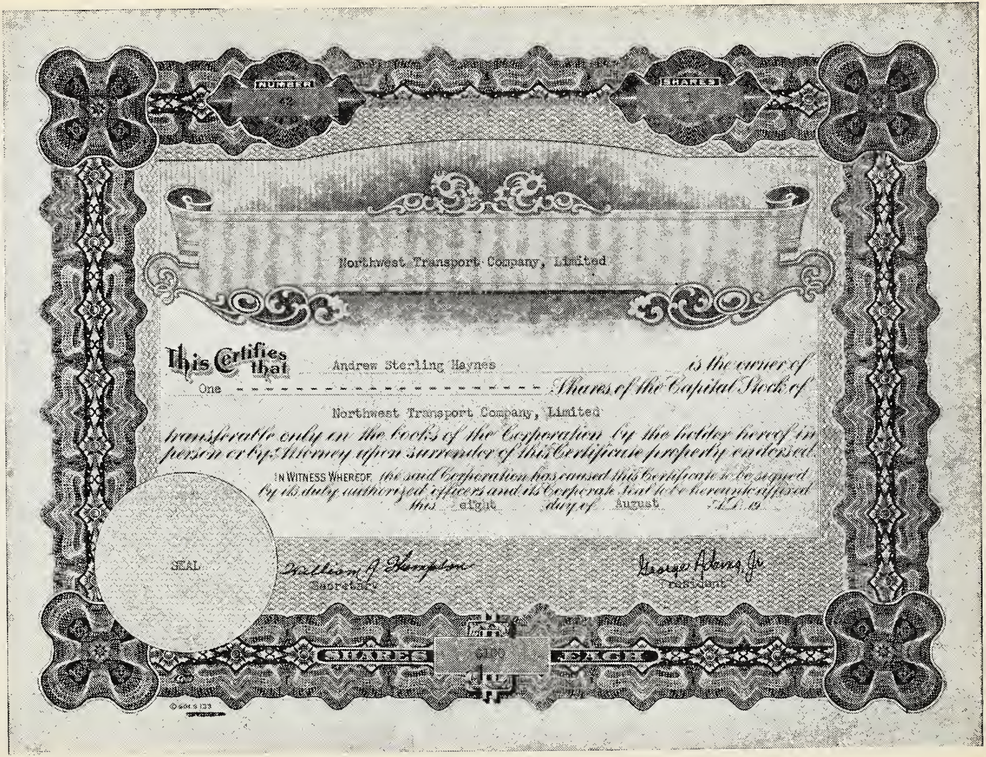
3. One share of this stock (problem 2) represents what part of the ownership of the company?

4. How many shares must I have to own 1% of this company (problem 2)?

5. In boom times the stock (par value $100) of one big corporation was selling at $279 a share (**market price**). What per cent of the par value was this?

6. During a period of hard times this stock dropped to $7.50 a share. What per cent was this of the par value?

7. The stock of this corporation is now selling for about $52 a share. What per cent is this of par?



NUMBER

SHARES

Northwest Transport Company, Limited

This Certifies that Andrew Sterling Haynes is the owner of One - Shares of the Capital Stock of Northwest Transport Company, Limited transferable only on the books of the Corporation by the holder hereof in person or by Attorney upon surrender of this Certificate properly endorsed.

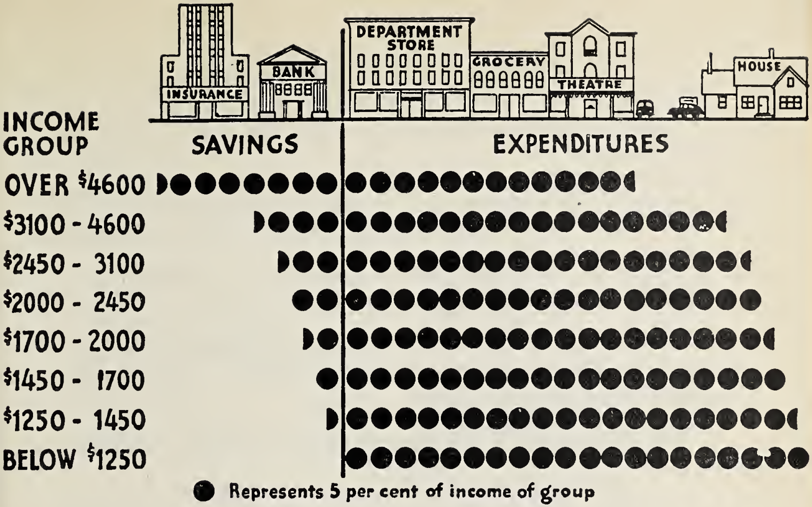
IN WITNESS WHEREOF the said Corporation has caused this Certificate to be signed by its duly authorized officers and its Corporate Seal to be hereunto affixed this eight day of August A.D. 19

SEAL

William J. Hampton
Secretary

George Adams, Jr.
President

SHARES $100 EACH



HOW MUCH SHOULD BE SAVED?

Families must have food, clothing, shelter, and other needful things. How much of the family income should go for these necessities and how much should be saved? The picture graph answers this question for families in eight income groups.

1. What does each disc on the graph represent?

2. How many discs are used to represent the income of each group?

3. About what per cent of income was saved by the $1250–$1450 group? If the average income for this group was $1320, what was the average savings?

4. How many of the income groups saved as much as 20% of their annual incomes?

5. The annual family income had to be at least what amount before the average savings were at least 10% of the income?

*INFORMATION PLEASE!

1. What number multiplied by itself has a product equal to the number?

2. The circumference of a circle was increased about 6 inches. By about what amount was its diameter increased?

3. By what fraction must a number be multiplied to have a product equal to one?

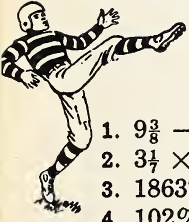
4. Which of the four fundamental processes may be performed on both numerator and denominator of a fraction without changing its value?

5. Multiplying by 5 is the same as dividing by what number?

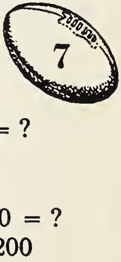
6. A 6-inch square has the same area as a rectangle. Give two sets of dimensions for the rectangle.

7. A diagonal is drawn from a vertex of a regular hexagon to the opposite vertex. What two figures are formed?

8. There are how many metres in 0.6 kilometres?



LET'S PRACTISE



	a	*b*	*c*
1.	$9\frac{3}{8} - 5\frac{3}{4} = ?$	$6039 \div 17 = ?$	$796 \times 308 = ?$
2.	$3\frac{1}{7} \times 6\frac{1}{4} = ?$	$3.7 \times 48.5 = ?$	$7 - .14 = ?$
3.	$18637 - 348 = ?$	$8\frac{1}{2} - 2\frac{3}{4} = ?$	$\frac{7}{8} = ?\ \%$
4.	102% of 540 = ?	$\frac{1}{4}\%$ of \$75,000 = ?	3.2% of 1460 = ?
5.	15 = ? % of 120	35 = ? % of 20	1 = ? % of 200
*6.	24 = 6% of ?	120 = 150% of ?	4.6 = 5% of ?

7. Express as per cents: *a*. 1.3; *b*. .006; *c*. $\frac{5}{6}$; *d*. .0325.

8. Arrange in order of size, beginning with the smallest: $\frac{3}{4}$, .7, $\frac{2}{3}$, 1, .1, $\frac{5}{8}$, 1.1.

USING THE VOCABULARY OF ARITHMETIC

Below are terms which were used in this chapter. Define each term or use it correctly in a sentence. If you have forgotten a term, turn to the key page in parentheses.

amount	(130)	mortgage	(136)
bond	(139)	par value	(143)
compound interest	(130)	principal	(136)
date of maturity	(139)	savings bank	(127)
dividend	(142)	sinking fund	(141)
face value	(139)	stock certificate	(143)
market price	(143)	stockholder	(142)

*TOPICS FOR SPECIAL REPORTS

1. What is the National Housing Act? How may the construction of a house be financed under this Act?

2. Find the meaning of the following: *a.* a mortgage bond; *b.* a debenture bond; *c.* a sinking fund bond; *d.* a serial bond.

3. What is the difference between common and preferred stock? Under what conditions would you recommend each as a good means of investment?

4. Secure information as to the exact procedure in depositing and withdrawing money in the Post Office Bank.

5. *a.* "Compound interest is interest on interest." What does that mean?
   b. Distinguish between compound interest and simple interest.
   c. What 3 things determine the amount of interest?

HOW WELL DO YOU REMEMBER?

1. Mrs. Moore deposited $1500 in a savings bank paying 1½% interest. What is the interest each year? the semi-annual interest?

2. Mr. Stanton bought a house for $7200 and gave a mortgage for 60% of the cost. What was the amount of the mortgage?

3. What was the yearly interest on Stanton's mortgage (problem 2) at 5½%?

4. If, at the end of each year, Mr. Stanton repaid $1000 of the money he had borrowed, what would be the amounts of his interest payments for the second and third years?

5. What is the chief thing to consider when investing money?

6. When interest is compounded annually, how much difference, if any, is there between simple and compound interest on $1000 at 2% for 1 year? for 2 years?

7. If a bond is bought at a discount, is it selling above or below its face value?

8. If a stock has a par value of $100 and it is sold at 87½, how much below par value is it selling?

*9. Using the table on pages 132-133, find the compound interest on the following:

a. $600, bearing interest at 3% per annum, compounded annually for 6 years.

b. $1700, bearing interest at 4% per annum, compounded semi-annually for 8 years.

c. $950, bearing interest at 5% per annum, compounded semi-annually for 4½ years.

THINGS TO REMEMBER

1. *What compound interest is and some of its uses.*
2. *What a mortgage is.*
3. *What a bond is and some of the different kinds of bonds.*
4. *What a share of stock is.*

TEST ON CHAPTER VI

1. Mrs. Brown had \$740 in a savings bank paying 1½%. How much interest was credited to her account at the end of 6 months?

2. How much more or less than simple interest is the interest on \$100 for 2 years at 2%, compounded annually?

3. How much will \$100 amount to in 2 years at 4%, compounded semi-annually?

4. Mr. Griffith bought a house for \$6800 subject to a mortgage of \$3500 at 5½%. What is the yearly interest on the mortgage?

5. Name three ways in which stocks differ from bonds.

6. A stockholder who bought stock at \$279 a share and sold at \$7.50 lost how much a share? what per cent?

7. Explain what is meant by "minimum quarterly balance."

8. A \$1,000, 4½% bond has coupons which may be cashed at six month intervals. What is the value of each coupon?

9. I bought a share of stock in a certain company, paying \$87.50 for it. At the end of 1 year, I received a cheque for \$2.50, as my share of the profits of the company. What % am I receiving on my investment?

10. A city issues \$1,000,000 of bonds, due to mature in 10 years, and puts aside money each year to redeem them. Why may they put aside *less than* \$100,000 per year?

PROGRESS TEST

If you make errors on this test, turn to the page in parentheses where the work is explained.

1. $502 \times 978 = ?$ (9) **2.** $.38\overline{)15.428}$ (22)

3. From $36\frac{3}{4}$ subtract $16\frac{11}{12}$. (15)

4. Add $7\frac{1}{4} + 11\frac{3}{8} + 9\frac{5}{6} + 4\frac{1}{2} + 5\frac{2}{3}$. (15)

5. How much more than 456.8 is 1000.5? (20)

6. Find the area of a square which is 7.5 feet on a side. (38)

7. Which is greater and how much, a rectangular rug $9' \times 12'$ or a rug $8\frac{1}{2}' \times 12\frac{1}{2}'$? (37)

8. Find the area of a triangle having a base, 8 inches, and an altitude, 15 inches. (40)

9. Find C in $C = \pi d$ when $d = 9$, and $\pi = 3.14$. (49)

10. Find the area of a circle whose radius is 14 inches. (Use $\pi = 3\frac{1}{7}$) (51)

11. A merchant received a bill for merchandise amounting to $420 less a discount of 35%. What was the net cost of the merchandise? (79)

12. $17\overline{)10033}$ (13) **13.** $37.5\overline{)1.7625}$ (22)

14. Express as common fractions: *a.* 50%; *b.* 75%; *c.* 60%; *d.* $37\frac{1}{2}$%. (60)

15. Arrange in order of size, beginning with the smallest: $\frac{5}{8}, \frac{3}{4}, \frac{1}{3}, \frac{1}{2}, \frac{5}{12}, \frac{2}{3}$. (15)

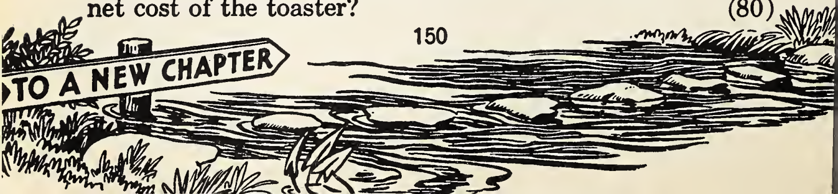
16. Find the interest on $650 at 3% for 4 months. (106)

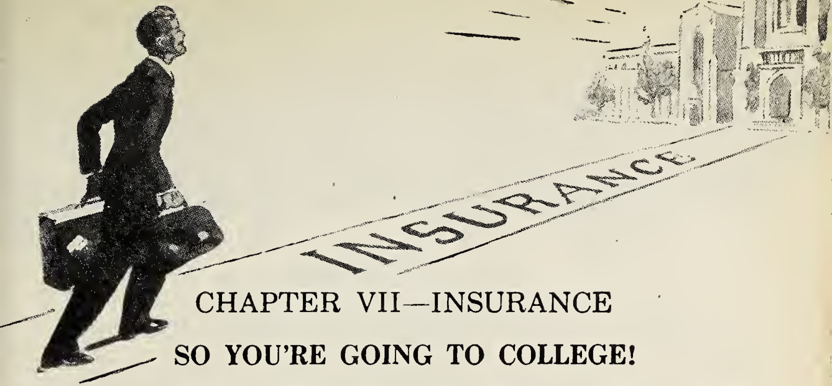
17. The interest on $150 for 1 year is $6. What is the rate? (108)

18. 145% of $2400 = ? (65)

19. 350 = ? % of 1400 (66)

20. An electric toaster was marked at $16, subject to discounts of 40% and 5%. What was the net cost of the toaster? (80)





CHAPTER VII—INSURANCE

SO YOU'RE GOING TO COLLEGE!

Ruth and Jerry Williams were going to college after finishing high school.

"How much does college cost?" asked Jerry. His father handed him a booklet, "College Costs," issued by an insurance company. According to the booklet, Jerry could get along on $250 a year at a provincial agricultural college, but Ruth might spend $1750 a year at a college for women.

1. What per cent of the women's college charge was the charge at the agricultural college?

2. What was the average of the two costs?

3. At what age do most people enter college? graduate from college? (Hint: Begin school age 6.)

4. The two children's education, Mr. Williams estimated, would cost him about $4000 each. If he began saving when the children were born, how much must he put away each year for 20 years? (Do not consider interest.)

5. But Mr. Williams bought insurance with his savings. He started when each child was born and paid $387.68 a year for 20 years. He paid in what per cent of what he drew?

6. How much less or more a year did his insurance cost than yearly deposits to his bank account (problem 4)?

SPREAD THE RISK

1. A class in the Rockledge School had a fund for lost books. Dues were 2¢ a week. How much was this a pupil for a term of 36 weeks? How much for a class of 40 pupils?

2. To each pupil in the class was issued a history ($1.12); a geography ($1.72); an arithmetic (88¢); a general science ($1.60); and several English texts ($1.40). Mary's books were burned. How much was she allowed from the fund?

3. John's history and arithmetic were taken from his locker. How much did the fund pay him?

4. At the close of the school year, $8.40 remained in the class book fund. How much was due each pupil?

5. What was the cost to each pupil for books lost?

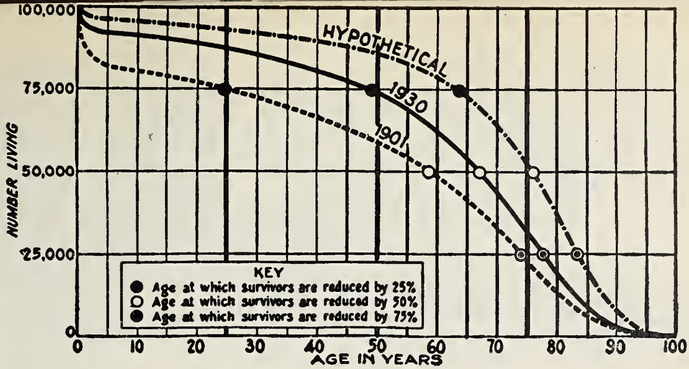
6. How much did Mary save by membership in the fund (problem 2)? John?

7. John's sister, Anna, pays 75¢ a week to the **"Health Chest"** conducted by the girls in the office where she is employed. How much is this a year?

8. During one year Anna was ill and out of the office for two weeks. The Chest paid her $10 a week sick benefits. Anna's dues were what per cent of her benefits?

9. Answer "yes" or "no" to the following questions:
   - *a.* Did the book fund prevent loss of books?
   - *b.* Did the fund spread the loss among many persons?

10. What do you call any plan that protects against money loss by spreading the risk among many people?



LIFE LINES

1. The graph includes how many newborn babies?

a. Of these 100,000 babies how many lived to age 25 under health conditions existing in 1901? What per cent is this?

b. How many lived to age 50 under health conditions existing in 1930? What per cent is this?

c. How many might have lived to age 65 if our people had followed all the good health rules they know?

2. A fourth of the babies were still living at what age under 1901 conditions? Under 1930 conditions?

3. A fourth of the babies should have lived to what age?

4. Notice that the graph has been divided by bold lines into quarters of 25 years each. In which quarter may we expect the life line to lengthen most?

5. In 1775 the average life of a person in this country was about 30 years; in 1850, 38 years; in 1900, 48 years; in 1930, 59 years; nowadays, 63 years. Show these life lines by means of a graph.

*6. *a.* Why are our life lines getting longer?

b. "Longer life lines mean higher insurance premiums." Is this statement true or is it false? Why?

PROTECT THE FAMILY

After Ruth and Jerry Williams had thought through the problem of their college expenses, Ruth asked, "But suppose Father should die?"

"Your $1000 a year would be paid by the insurance company as if I had lived," said Mr. Williams, joining them unexpectedly.

"How about Mother?" questioned Jerry.

"I have a written agreement with the same insurance company to protect her," replied his father. "I pay $188 a year. At my death the insurance company pays Mother $10,000."

1. *a.* If Mr. Williams paid under this agreement for 20 years, how much more or less would Mrs. Williams receive than her husband had paid? What per cent more or less?

b. How much and what per cent more or less if Mr. Williams paid for 30 years? 40 years?

2. In the business transaction between Mr. Williams and his insurance company, what do you call Mr. Williams? the company? the agreement? Mrs. Williams? $10,000? $188?

The following terms answer the above questions. Match question and term. Premium; insurer; policy; beneficiary; insured (or policyholder); face of policy.

3. A company sells to 1000 people, age 25, $1000 of insurance for each person. If 8 of these people die in one year, how much must the insurance company pay? How much is this for each of the 1000 persons insured?

4. Why is the amount charged each policyholder (problem 3) called the **mortality cost**?

5. Insurance companies have certain costs and expenses of doing business, and they must earn a profit. If these items total $10,000 a year for the company (problem 3), how much premium must each policyholder pay? (HINT: Mortality cost plus expenses and profits.)

6. "But how long do people live?" queried Jerry. This is answered, in part, by the following mortality table.

EXPECTANCY OF LIFE			EXPECTANCY OF LIFE			EXPECTANCY OF LIFE		
AGE	MALE	FEMALE	AGE	MALE	FEMALE	AGE	MALE	FEMALE
0	60	63	35	34	36	70	9	10
5	60	62	40	29	32	75	7	8
10	55	58	45	25	28	80	5	6
15	51	53	50	22	24	85	4	4
20	46	49	55	18	20	90	3	3
25	42	46	60	15	16	95	2	2
30	38	40	65	12	13			

a. A boy at birth has a fair chance of living to what age? a girl?

b. How much longer may your sister (age 15) expect to live? At what age (as by the table) **may** she die?

c. What will be the average age at death of men and women now 20 years old? 40 years? 60 years?

d. A man 80 years of age can reasonably expect to live how much longer? a woman?

CHOOSE YOUR PROTECTION

1. The following table names 3 kinds of insurance policies. What are they?

Age	Ordinary Life	20-Payment Life	Endowment	
			20-Year	30-Year
21	$15.75	$22.95	$44.20	$27.60
25	17.35	24.95	44.45	27.90
30	19.95	27.80	44.95	28.95
35	23.40	31.40	45.95	30.55
40	28.05	35.95	47.75	33.30
45	34.15	41.70	50.70	37.65
50	42.30	49.00	55.40	44.30

2. One of Mr. Williams' policies is an "ordinary life policy." He bought it at age 25. He must pay the premiums **as long as he lives.** If he dies at age 75, how much will the insurance company have received from him? How much will it pay to his family? (HINT: Life insurance is usually priced at so much a $1000.)

3. Williams' neighbour has a "20-payment life policy." (He might as easily have bought a "one-payment life" or a "50-payment life," or any other number of years.)

a. If Neighbour took out the policy at age 30, how many payments must he make?

b. How much will he have paid at age 50?

c. How much must he pay (if any amount) during his 51st year? Explain.

d. If he dies at age 32, how much will his family receive? Will the family be required to pay the remaining 18 premiums? Explain.

e. If Neighbour lives beyond age 50, when will his policy become due and payable? Why?

4. Mrs. Williams has a "20-year **endowment** policy," which she took out at age 21, before she was married.

a. How much is the annual premium on the policy? The total premiums?

b. For how many years must Mrs. Williams pay the premiums (if she lives)?

c. If Mrs. Williams had died at age 24, how much would her family have received? Would the family be required to pay the remaining 17 premiums? Explain.

d. In a year or so Mrs. Williams will be 41 years of age. Will she, at that time, receive $1000 from her insurance company, or must she "die to win"? Answer the question "Yes" or "No," but be sure to give your reason. REMEMBER: **Endowment** means **money or property given to a person.**

5. For which kind of policy are the premiums largest? What do you think are the reasons for this?

6. For what kind are the premiums smallest? Why?

7. How much less are the premiums for insurance taken out at the age of 21 than at the age of 25?

8. Why are the premiums for age 21 less than those for age 25 or 30?

9. What is the yearly premium of a 20-payment policy for $5,000 insurance taken out at the age of 21? 30? 40?

10. What reasons can you give for taking out insurance at an early age?

11. Insurance agents are paid commissions on the premiums for the insurance they sell. What is the amount of the commission on an ordinary life policy taken out at the age of 30 for $5,000 if the rate of commission is 20% of the first premium?

12. What is the sum total of all premiums paid on a 20-year endowment policy for $2,000, taken out at the age of 25?

13. What will the premiums on an ordinary life policy for $1,000, issued at the age of 25, amount to in 40 years? Is this more or less than the face of the policy?

14. What will the premiums on a 20-year endowment policy for $1,000, issued at the age of 30, amount to in 20 years?

15. If you take out an ordinary life policy at age 21, how much will you have paid in premiums at age 40? at age 60?

16. What are the yearly premiums on the following policies at the rates on page 156?

a. Issued at the age of 21, ordinary life, face $6,000.

b. Issued at the age of 25, 20-year endowment, face $2,000.

c. Issued at the age of 35, 20-payment life, face $3,000.

d. Issued at the age of 40, ordinary life, face $6,000.

e. Issued at the age of 35, ordinary life, face $3,500.

*17. Are the rates for men and women the same? Can aviators be insured against death or accident? What effect has war on insurance?

*18. Would you recommend that a person invest all his savings in bonds and mortgages instead of using part of them for insurance? Why?

1. How much insurance will Mrs. Williams receive on the death of her husband (page 154)?

2. Mrs. Williams may take the $10,000 as a **lump sum** (all at one time) or as an **annuity** (so much each year). The annuity will pay her $1128 a year for 10 years. How much more will she receive as an annuity (if she lives for the full time) than as a lump sum? What per cent more?

3. If at age 65 Mr. Williams has $40,000 invested in 3% bonds, what will be his monthly income?

4. If he begins saving at age 45, how much must he deposit each month to save $40,000 by age 65? (HINT: Do not include interest on savings.)

5. How long Mr. and Mrs. Williams may expect to live after reaching ages 60 and 65 is shown by the table.

RETIRING AGE	WILL LIVE AFTER RETIRING	
	MALE	FEMALE
60	219 months	261 months
65	180 months	219 months

a. How many more years will a man live (on the average) who has reached age 60? 65? A woman?

b. Why does an annuity cost more for a woman than for a man of the same age (See table)?

6. At age 65 Mr. Stanton has $15,000 invested in 4½% bonds. What will his yearly income be from the bonds?

7. If Mr. Stanton, at age 65, should invest $15,000 in an annuity, his yearly income would be $1500. How does this compare with the income received from his bonds?

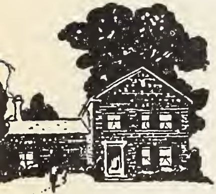
8. At age 60, the average annual income from an annuity is about 8% of its face value for women and 9% for men. If an annuity has a face value of $15,000, find the average annual income at age 60 for a man; for a woman.

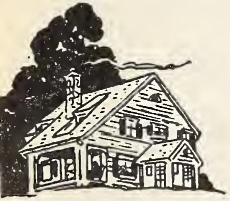
FIRE!

1. In Canada about 138 fires are reported each day. How many is this a year (365 days)?

2. Our total fire loss a year is now about $30,000,000. How much is this for each person in our country (11,500,000)? for your family?

3. The annual fire loss in England is about 72¢ a person; in France, 49¢; in Switzerland, 15¢; and in Holland, 11¢. What per cent of our fire loss a person is the loss in each of the European countries?

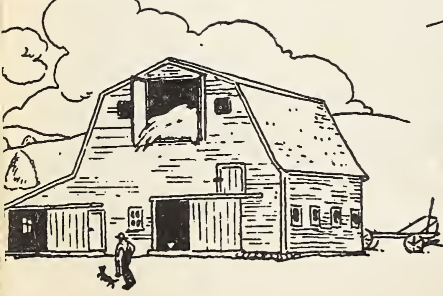


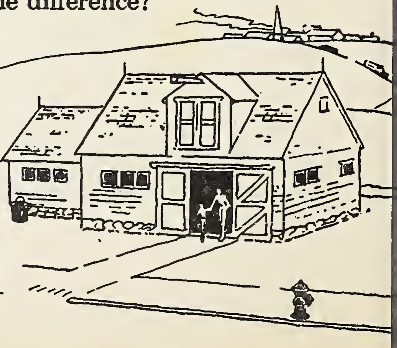


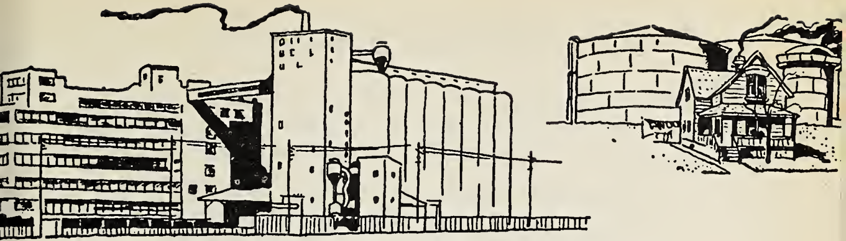
4. Our worst fire-loss year was 1929—$47,500,000. How much more is this than our present average fire loss? What per cent more?

5. Here are 2 houses. The brick house may be insured against fire at $.10 for each $100 of insurance; the frame house at $.20. How much more does protection cost for frame than for brick? What per cent more? Why the difference?

6. Here are 2 barns. The **up-country** barn can be insured against fire at 78¢ for each $100 of insurance; the **suburban** (close to city) barn at 70¢. The "suburban" premium is what per cent of the "up-country" premium? Why the difference?







7. This factory can be insured against fire at 60 cents for each $100 of insurance. What per cent of the "factory" premium is the brick house premium (problem 5)? Why the difference?

8. The "not-so-nice" house near the refinery can be insured against fire at 25 cents for each $100 of insurance; the playhouse in the park at 10 cents. What per cent of the "not-so-nice" house premium is the playhouse premium? Why the difference?

★9. By solving problems 5-8 you learned that **structure, location, use,** and **surroundings,** determine the premium rate in fire insurance. Why?

★10. *a.* What is a "fireproof" building?

b. Why are all buildings not fireproof?

c. "At home we have a **paid** fire department," said Jerry Williams, "but at the seashore the fire department is a **volunteer** company." What did Jerry mean?

d. "And less fires mean lower insurance premiums," added Mr. Williams. What did he mean?

e. The mayor of the town in which the Williams lived said, "My administration has given you motor-driven fire trucks. The horses are gone. You pay less insurance." What did the mayor mean and why?

PAYING FOR FIRE PROTECTION

Fire insurance premiums on buildings of the same type vary from place to place. There are many reasons for this difference, some of which you have studied (pages 160-161). In one Canadian city the fire insurance rates are as follows:

BRICK HOUSE	FRAME HOUSE
14¢ a $100	20¢ a $100

For 3-family apartment houses, add 1¢ to above rates.
For 4-family apartment houses, add 2¢ to above rates.
For 5-family apartment houses, add 10¢ to above rates.

For apartments which house from 6 to 10 families, add 1¢ for each extra family to the cost for a 5-family house.

1. A one-family brick house is insured for $7500. What is the annual premium?

2. A 3-family apartment is insured for $10,000. What is the premium? an 8-family apartment at $15,000? a 10-family apartment at $20,000? Why the difference?

3. What is the annual fire insurance premium on a one-family frame house insured for $3750?

4. The fire insurance premium on the furnishings and other contents of a 5-family apartment is 40¢ for each $100 of insurance. How much higher is this than the premium on the building? What per cent higher? Why the difference?

5. A large country residence, valued at $20,000, is insured against fire for $16,000. What per cent of the valuation is the insurance?

6. A house, insured for $8000, was burned to the ground—a total loss. The insurance company offered the owner $6000, the cost of rebuilding the house. The owner sued the company for the full $8000. What do you think was the result?

BARGAIN RATES

"Buy fire insurance for periods longer than one year and buy it cheaper," is good business, as shown in the table.

PERIOD	RATE
2 years	$1\frac{3}{4}$ times the rate for 1 year.
3 years	$2\frac{1}{2}$ times the rate for 1 year.
4 years	$3\frac{1}{4}$ times the rate for 1 year.
5 years	4 times the rate for 1 year.

1. What per cent may be saved by buying fire insurance for a 5-year period instead of for five 1-year periods? What amount may be saved at an annual rate of 20¢ a $100?

2. A small dwelling is insured for $3500 at 15¢ a $100. (REMEMBER: This is the yearly rate.) How much can be saved over a period of 15 years by buying 3 5-year policies instead of 5 3-year policies? What per cent can be saved?

3. Mr. Russell insures his house each year for $3600 at 29¢ a $100. How much could he save during a 5-year period by taking out a 5-year policy?

4. A city turned in its fire trucks for the very latest model fire-fighting apparatus. The new equipment had not been long in use before fire insurance premiums in the community dropped from 14¢ to $12\frac{1}{2}$¢ a $100 on brick dwellings and 19¢ to 18¢ on frame. What was the per cent reduction for brick? for frame?

5. Find the annual savings (problem **4**) to an owner of a brick dwelling insured at $7500; a frame dwelling insured at $4800.

6. Records of fire insurance companies for a recent year showed that 52% of premiums were retained by the companies and 48% went to fire losses. Show these facts by a circle graph.

FIRE INSURANCE—PROBLEMS

Here are the fire insurance rates in a certain city.

Type of Building	Rate on $100	
	1 Year	3 Years
One-family house:		
Shingle roof	30¢	75¢
Composition roof	26¢	65¢
Two-family house:		
Shingle roof	36¢	90¢
Composition roof	30¢	75¢

1. Why are the rates on a building with a shingle roof higher than the rates on a building with a composition roof?

2. Why are the rates on a two-family house higher than the rates on a one-family dwelling?

3. Find out the rates on similar buildings in your city.

4. Find the premium on a $2,000 insurance policy for a one-family house with a composition roof at the above rates for 1 year; for 3 years.

5. Find the premium on a two-family house with a shingle roof for a policy of $6,000 for 1 year; for 3 years.

6. Find the premiums on each of the following policies:

a. $600 at $\frac{1}{2}$% premium	*c.* $4,800 at $1\frac{1}{2}$% premuim
b. $750 at $\frac{3}{5}$% premium	*d.* $7,500 at $\frac{3}{4}$% premium

Property is not always insured for its full value, since only rarely are buildings entirely destroyed. Usually a building is insured for from 50% to 75% of its value.

7. A house worth $8,500 was to be insured for $6,500 at 25¢ a hundred for 1 year or 70¢ a hundred for 3 years. Find the premiums for each period of time.

8. A man decided to insure his $10,000 house for 75% of its value. The rate for 1 year was 31¢ a hundred, for 3 years 85¢ a hundred. How much would he save by taking out the same amount of insurance for 3 years?

LET'S PRACTISE

Set I

1. $\begin{array}{r} 9\frac{1}{4} \\ -3\frac{5}{8} \\ \hline \end{array}$ **2.** $\begin{array}{r} 407 \\ \times 309 \\ \hline \end{array}$ **3.** $\begin{array}{r} 34701 \\ -18906 \\ \hline \end{array}$ **4.** $28\overline{)7565}$

5. $36 \div \frac{4}{9} = ?$ **6.** $9\frac{1}{4} \times 3\frac{2}{3} = ?$ **7.** $3\frac{1}{2} \times 15 = ?$ **8.** $\begin{array}{r} .145 \\ -.076 \\ \hline \end{array}$

9. $\begin{array}{r} 3.8 \\ \times 2.9 \\ \hline \end{array}$ **10.** $2\frac{1}{4} \div 4\frac{1}{2} = ?$ **11.** $.04\overline{)16}$ **12.** $2.25\overline{)18}$

13. $736 + 529 + 1728 + 807 + 3259 + 160 = ?$

14. $9 + 4\frac{1}{2} + 3\frac{5}{8} + 6\frac{1}{4} + \frac{7}{8} = ?$

Set II

Find the missing amounts:

1. 15% of 360 = ?
2. 170% of 400 = ?
3. $\frac{1}{2}$% of 1700 = ?
4. $33\frac{1}{3}$% of 570 = ?
5. 16 = ?% of 80
6. 75 = ?% of 50
7. 94 = ?% of 94
8. 50 = ?% of 80
9. 140% of 80 = ?
10. 60 = ?% of 72
11. 72 = ?% of 60
12. $\frac{3}{4}$% of 1200 = ?
13. 50% more than 48 = ?
14. 25% less than 80 = ?
15. 100% more than 19 = ?
16. 5% less than 50 = ?
17. .7% of 350 = ?

★18. 12 = 10% of ?

★19. 36 = 25% of ?

★20. 80 = 150% of ?

★21. 300 = 200% of ?

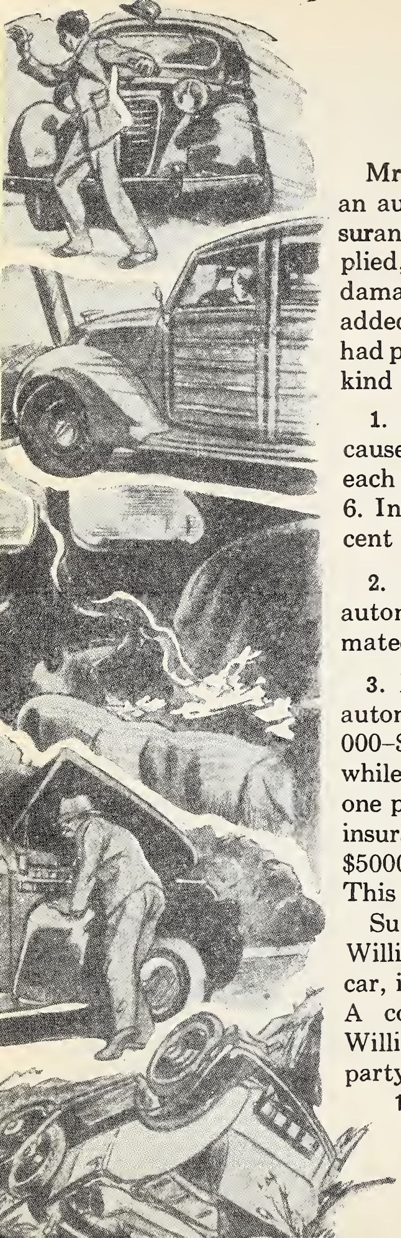
★22. 36 = $66\frac{2}{3}$% of ?

★23. 60 = 120% of ?

★24. 90 is 15% of ?

25. Express the following as per cents: *a.* $\frac{3}{4}$; *b.* $\frac{3}{8}$; *c.* $\frac{2}{3}$; *d.* 4; *e.* 1.025; *f.* .8; *g.* $1\frac{1}{4}$.

26. Express as decimals to the nearest hundredth: *a.* $\frac{5}{6}$; *b.* $\frac{4}{9}$; *c.* $\frac{7}{8}$; *d.* $\frac{2}{3}$; *e.* $\frac{8}{9}$; *f.* $\frac{7}{16}$; *g.* $\frac{4}{7}$.



DRIVE CAREFULLY

Mr. Williams owns and drives an automobile. Asked what car insurance he carried, Williams replied, "Public liability, property damage, fire, and theft." Had he added "collision," he would have had protection against almost every kind of automobile accident.

1. In 1926 the number of deaths caused by automobile accidents for each 100,000 of our population was 6. In 1943, 12. What was the per cent increase?

2. How many deaths were due to automobile accidents in 1943 (estimated population 11,700,000)?

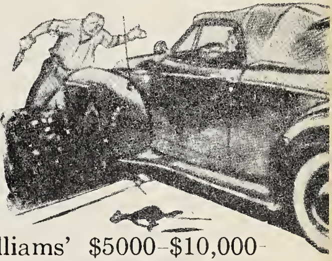
3. Mr. Williams calls one of his automobile policies a "$5000-$10,000–$1,000 policy." If Williams, while driving his car, injures some one person, other than himself, his insurance company will pay up to $5000; two persons, up to $10,000. This is **public liability** insurance.

Suppose, for example, that Jerry Williams, while driving the family car, injured 2 people rather badly. A court of law said that Mr. Williams must pay each injured party $6000.

How much would Williams' insurance company pay? What per cent of the claim must Mr. Williams pay?

4. Under the $5000–$10,000–$1000 policy Mr. Williams' insurance company must pay up to $1000 for damage caused by Williams' car to the property of another person. (This is called **property damage.**)

Suppose, for example, that Mrs. Williams, to avoid hitting a kitten on the road, ruins a front hedge of an adjoining property. How much will the insurance company pay? (HINT: You supply the figures for this problem.)



5. The annual premium on Williams' $5000–$10,000–$1000 policy was $60: $51 for public liability insurance; $9 for property damage. What per cent of the premium was paid for each type of protection?

6. Williams might have bought a $10,000–$20,000–$1000 policy at a premium 7% higher than the $5000–$10,000–$1000. Find the cost of this larger protection.

7. What is meant by each item in the policy: $10,000–$20,000–$1000?

8. One of Williams' neighbours has a $10,000–$20,000–$1000 policy on his car. He skidded on a wet pavement and crashed into the plate-glass window of a beauty parlor. Two women were hurt by splinters of glass. What is the largest amount for which the company may be liable?

9. The auto insurance company paid the beauty parlor owner $500 for property damage and settled with each of the injured women for $1000. What per cent was this of what the company might have had to pay?

★10. Why can you buy twice as much public liability protection without doubling the premium?

*REWARDS FOR CAREFUL DRIVERS

1. Accidents add about 1¢ a mile to the cost of operating an automobile. If Mr. Average Driver's speedometer registers 7800 miles a year, how much extra do accidents cost? What per cent extra is this if Mr. Average Driver operates his car at 6¢ a mile?

2. Some companies encourage careful driving by allowing drivers a **rebate** if they have had no accidents during the year. Find out if this policy is in effect in your province.

3. Find out from your local car insurance agent what happens when a driver has a bad record for accidents. How do insurance companies find out about drivers who have numerous accidents?

4. Find the yearly premium on a \$5000–\$10,000–\$1000 automobile insurance policy in your community. What per cent is it of Williams' premium (page 167)?

5. "You must carry automobile insurance," says the law in some of our provinces. Give one advantage, one disadvantage of such a law. Have you such a law where you live? If so, how much insurance must the car owner carry?

6. Harold said, "If everybody were required by law to carry car insurance, drivers would be even more careless than they are now." What do you think?

7. "Drive carefully, avoid accidents, and you will be charged only 85% of our regular rate for your liability insurance," wrote an auto insurance company to its policyholders. Six owners and drivers took the company's advice and received bills for:

a. \$38.25	*b*. \$42.25	*c*. \$27.54
d. \$51.85	*e*. \$28.90	*f*. \$22.10

What were the regular premiums?

LOCK YOUR CAR!

1. In 25 cities, having a total population of about 3,500,000, there were 5,500 automobiles stolen during a recent year. About how many was this, on the average, for each city?

2. If the same rate held for all of Canada, about how many cars would be stolen in our country each year (population of Canada about $3\frac{1}{3}$ times the population of cities given)?

3. What per cent would be stolen? (HINT: Canada has about 1,200,000 automobiles.)

4. In Mr. Williams' community, insurance protection against theft of one's car and fire damage cost per $100:

KIND OF CAR	FIRE INSURANCE	THEFT INSURANCE
Low-priced car	$.40	$1.40
Middle-priced car	.30	.85
High-priced car	.25	.75

Williams paid $1850 for a new car. What was his theft premium? fire premium (HINT: Middle-priced car)?

5. If Williams' car had been in the low-priced class, let us say $1425, how much premium would he pay for fire and theft insurance?

6. Williams' insurance company estimates that an automobile loses value at the rate of 2% a month on its purchase price. What was the value of Williams' car after 8 months?

7. If Williams' car were stolen after he had it 8 months, and was not recovered, what per cent of its purchase price would the insurance company pay?

8. After Williams had driven his car 18 months, it was completely destroyed by fire. How much would the company pay him? (HINT: Allow 2% per month for depreciation.)

NISI DOMINUS FRUSTRA

THE BLUE CROSS

In Mr. Williams' community is the Blue Cross, one of several easy-payment plans for sharing the risk of hospital expenses when one is ill or injured.

The Blue Cross accepts persons who enrol as a group at the place of employment. Dues are deducted from the members' pay, and forwarded to Blue Cross by the employer. Dues and benefits vary slightly from place to place, but cost approximately as follows, for semi-private hospital accommodation (2 to 4 patients in one room):

One person	$ .75 a month
Man, his wife and children under 16 years of age	$1.50 a month

1. How much a year does Blue Cross membership cost the Williams' family? (Ruth and Jerry are under 16.)

2. What is the average annual Blue Cross cost for each member of the family?

3. The average hospital stay is about 13 days a patient. At that rate, how much is Miss Average Patient's hospital bill, at $5.50 a day?

4. Each Blue Cross patient is entitled to free hospital accommodation as follows:

First Year	31 days	Fourth Year	46 days
Second Year	36 days	Fifth Year and each year thereafter	51 days
Third Year	41 days		

Where the rate is $5.50 a day, what is the most any Blue Cross member may receive for hospital accommodation in any one year?

5. If Miss Blue Cross, in the third year as a member, occupies a hospital bed for 44 days, how much must she pay to the hospital? (Assume a cost of $5.50 a day.)

6. If Miss Blue Cross wishes a private room, at $8.00 a day, in this hospital, how much a day will Blue Cross pay? How much must she pay?

7. The average Blue Cross patient stays in the hospital nine days. At $5.50 per day, how much does he save by being a Blue Cross member? (HINT: Don't forget the $9.00 fee.)

8. Mr. Hodgins and his family (Blue Cross members for two years), are in an automobile accident.

a. How much has membership cost them since joining?

b. As a result of the accident, the family's hospital record is as follows: Mr. Hodgins 26 days, Mrs. Hodgins 15 days, Jerry 4 days, Bob 1 day. How much do they save by Blue Cross Membership?

*9. How does the hospital plan in your community resemble and differ from the Blue Cross?

USING THE VOCABULARY OF ARITHMETIC

Define or use correctly in a sentence each term given below If you have forgotten the meaning of a term, refer to the key page number in parentheses.

annuity	(159)	limited-payment-life policy	(156)
beneficiary	(154)	mortality table	(155)
Blue Cross	(170)	policyholder	(154)
endowment policy	(157)	premium	(154)
face of policy	(154)	property damage	(166)
hospitalization	(170)	public liability	(166)
life expectancy	(155)	straight-life policy	(156)

*INFORMATION PLEASE!

1. Select any kind of insurance (not studied in this chapter) for a brief floor talk to your class. Here are three kinds from which to choose. There are dozens of others.

   a. Marine insurance
   b. Travellers insurance
   c. Crop insurance

2. "Our city was rated 'A' by the fire underwriters," said Mr. Williams.

   a. What is an underwriters association?
   b. What is an "A" rating and how does it affect insurance premiums?

3. "My insurance dividend this year," said Mrs. Williams, "was $4.65." What did she mean?

4. "What happens to our insurance premiums?" is a very important question indeed. How would you answer it?

5. Prepare a report on Canada's Unemployment Insurance Act.

6. What is collision insurance?

HOW WELL DO YOU REMEMBER?

1. Mr. City and Mr. Country drive the same make and age of automobile insured for like amounts. City pays $44 a year premium; Country, $32. What per cent more does City pay than Country for the same protection? Why?

2. Mr. Young Man and Mr. Middle Age buy life insurance the same day. Their policies are as alike as can be. Young Man pays $30 premium a year; Middle Age, $45. What per cent less does Young Man pay than Middle Age for the same protection? Why?

3. Mr. Roberts pays $27.35 a $1000 for life insurance. If he carries a policy of $12,500, what is his premium?

4. A mortality table gives the death rate at age 25 as 8.065 a 1000. If 12,000 persons, 25 years of age, buy policies, how many deaths, to the nearest whole number, may be expected during the year from this group?

5. If the average death claim is $1600 (problem 4), what will the death claims total?

6. A house is insured for $6500 against fire at 54¢ a $100 for 3 years. What is the premium? the average yearly cost?

7. A new car, costing $1500, is fully insured against fire at 30¢ a $100, and theft at 65¢ a $100. Public liability and property damage cost $58. Find the total premium.

8. Mr. Witt carried no liability insurance on his car. He had an accident which cost him $6000 to settle. At a yearly premium of $75, for how many years could he have carried liability insurance with this amount?

9. A member of the Jones family was confined to a hospital for 14 days at an average cost of $6 a day. The family could have carried hospitalization insurance for $24 a year. How much could the family have saved by providing hospitalization insurance?

THINGS TO REMEMBER

1. *What is insurance and the different kinds of insurance.*
2. *What things help to determine premiums.*
3. *What is an annuity and how it differs from life insurance.*
4. *How property may be protected against loss by fire or theft.*

TEST ON CHAPTER VII

1. What is one's **expectancy of life?**

2. How is the cost of a life insurance premium affected by the age of the individual when the policy is taken?

3. For any given age, which of the following types of premiums will be highest, and which lowest: ordinary-life, 20-year endowment, or 20-payment life? Why?

4. What is the difference between life insurance and an annuity?

5. Under what conditions would you recommend an annuity?

6. What are some of the things which determine the rate a $100 for fire insurance on a house?

7. The rate for fire insurance on a house in a certain city is 24¢ a $100 for 1 year, or 60¢ a $100 for 3 years. The rate for a 3-year period is how many times the annual rate?

8. A house, valued at $7500, is insured against fire loss for 80% of its value at 48¢ a $100 for 3 years. What is the premium? the average cost each year?

9. What is public liability insurance? hospitalization insurance?

10. "I have a $5000–$10,000–$5000 public liability and property damage policy." Explain the terms of this policy.

11. How is the rate for theft insurance on a car affected by the locality in which the owner lives?

PROGRESS TEST

Solve the problems and perform the indicated operations. If you made errors on this test, turn to the key pages in parentheses, where the work is explained.

1. $11\frac{3}{10} - 6\frac{4}{5} = ?$ (15) 3. $4\frac{1}{4} + 3\frac{5}{8} + 1\frac{1}{2} + 7\frac{3}{4} = ?$ (15)
2. $2\frac{1}{2} \div 2\frac{1}{6} = ?$ (18) 4. $6 \div .8 = ?$ (22)

5. The sum of two numbers is 96.2 and one of the numbers is 38.5. What is the other number? (20)

6. The product of two numbers is 251.25. If one of the numbers is 6.7, what is the other number? (22)

7. $.312 \div 78 = ?$ (22) 8. $2\frac{1}{4} \times 3\frac{1}{7} \times 5 = ?$ (16)

9. Arrange the following decimals in order of size, placing the largest first: .1, .08, .096, .6, .01, .325. (20)

10. 36% of 80 = ? (65) 13. $\frac{1}{2}$% of 720 = ? (72)
11. 48 = ? % of 24 (66) 14. 72 = ? % of 360 (66)
*12. 10 = 5% of ? (74) *15. 40 = 8% of ? (74)

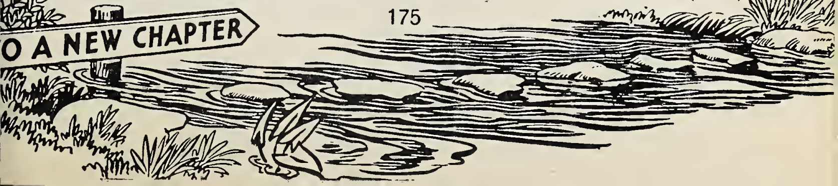
16. If not over 15 units are to be shown on a bar graph, what would be a convenient scale to use when the largest number to be graphed is: *a*. 46? *b*. 110? *c*. 280? *d*. 550? *e*. 2900? (92)

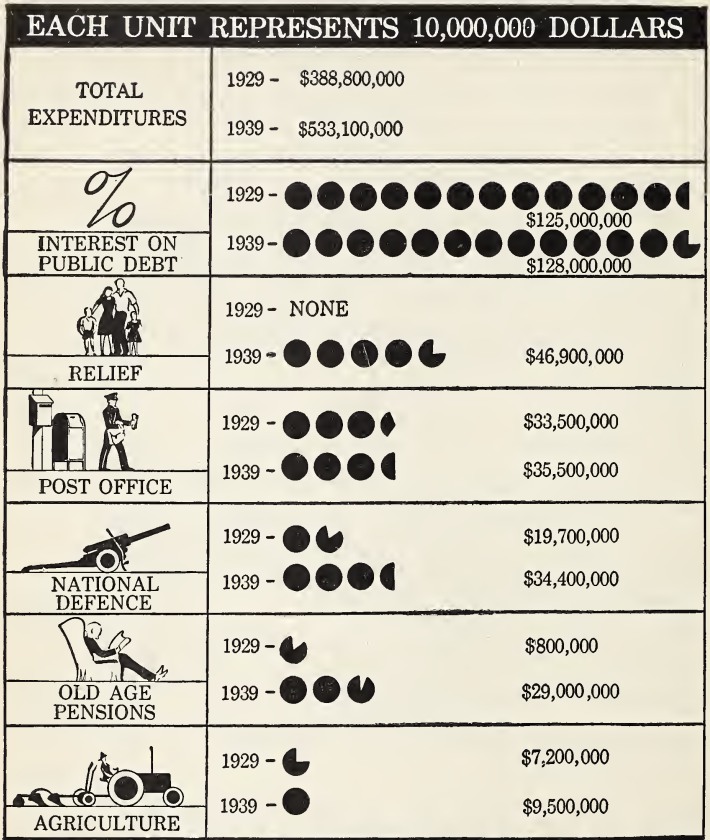
17. The cost of goods to a merchant is 60% of his sales, and the margin 40% of the sales. Show these amounts by a circle graph. (99)

18. At a rate of 35%, find the commission on sales amounting to $120. (65)

19. Using the formula $i = prt$, find i when $p =$ \$460, $r = 3\%$, and $t = \frac{1}{2}$ year. (106)

20. What is the value at maturity of a 60-day note for $730 bearing interest at 5%? (115)





HOW DOMINION SPENDING HAS CHANGED.

CHAPTER VIII

GOVERNMENT—OUR BIGGEST BUSINESS

The biggest business in Canada is the Dominion Government. It takes in more money (taxes) and pays out more money in wages and service than does any private business or group of private businesses.

The graph on page 176 shows the change in a few items of government expenditure during the ten years preceding World War II. (The enormous expenditures of the war years are not typical of peace-time conditions.)

1. How much did the Dominion Government spend in 1929? in 1939?

2. What was the percent of increase from 1929 to 1939?

3. Some big items of government expense in 1939 did not exist in 1929. What were these items?

4. Rank the 1939 items of Dominion spending in order of size.

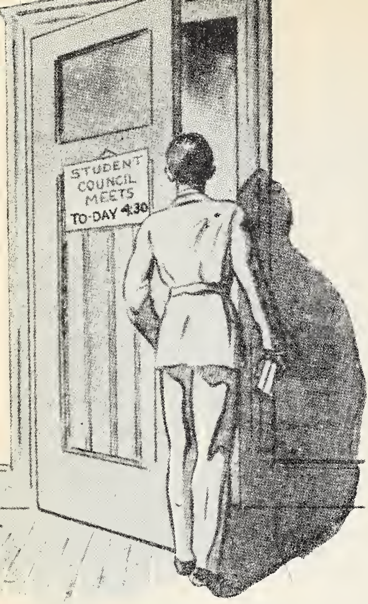
5. How much of the total spent in 1939 is not accounted for on the graph?

6. Give one example of each item of government spending on this graph.

7. During the war years Canada's total expenditures increased as follows: 1939, .5 billion; 1940, .7 billion; 1941, 1.2 billions; 1942, 1.9 billions; 1943, 4.4 billions; 1944, 5.3 billions. Show these expenditures by a vertical bar graph.

8. How much did the expenditure of 5.3 billions cost each person in Canada on the average? (Hint: Population, 10,700,000).

9. What evidence on the chart indicates that our big business of government is getting bigger? What effect may this have in "balancing the budget"?



PAYING THE COST OF GOVERNMENT

The pupils of the Glenview School have a "Student Association" which all members of the student body may join and most of them do. Each home room elects one of its number as a representative to the "Student Council" which controls all student activities.

1. The Council adopted and referred to the Association for approval the following budget. What was the total of the estimated expenditures as listed in the budget?

Student Association Budget

Boys' and girls' athletics	$225
Five issues of school paper	175
Social functions	40
Christmas party	25
Club activities	100
Bus hired for excursions	60
Student handbook	50
Total	?

2. What per cent of the total spending was allotted to each item in the budget?

3. If the Glenview School enrolled 750 pupils, and 600 were members of the Student Association, what per cent was that?

4. What per cent of the student body was not members of the association?

5. What was the average budget cost a pupil? a member of the Association?

6. The yearly dues, 75¢, of the Student Association were payable 40¢ in September and 35¢ in February. If a pupil wished to pay monthly, the dues were 10¢ a month for 10 months. What per cent could be saved by paying in two instalments?

7. If $\frac{1}{3}$ of the pupils agreed to pay their dues semi-annually and the remainder monthly, what were the estimated yearly receipts from dues?

8. What per cent of the annual budget was raised from dues? from other sources?

9. Pupils, not members of the Association, were charged 25¢ admission to all athletic events. If one of these non-members attended 5 games, how much might he have saved by joining the Association and paying his dues yearly? monthly?

10. What per cent might he have saved by yearly payments? monthly payments?

11. If people in the community began to attend the school games (football, basketball, baseball, soccer) in increasing numbers, admission 50¢, how might this affect the pupils' dues?

12. If the Student Association took on other activities, as, for example, school decoration, how might this affect the budget? the dues?

*13. If you have a Student Association in the school which you attend, solve problems 1-12 in reference to your local organization.

A CITY BUDGET

The citizens of your community also have an "association." You, and all your neighbours, are "members" even though you may never have "joined." You are **taxpayers.** You pay money (**taxes**) for the support of government in your neighbourhood and in the larger neighbourhoods of province and nation.

When you are of age, you will vote for men and women to look after community services such as water supply, public safety, schools. One of the important jobs of these municipal councils, city councils, school trustees, or whatever the governing body may be, is to prepare a budget of estimated expenditures. Here is such a budget for a city of 25,000 population.

ITEMS	AMOUNT	PER CENT OF TOTAL
1. Parks and public property	$ 40,049	?
2. General administration	28,300	?
3. Public works	122,966	?
4. Public safety	98,780	?
5. Health and sanitation	24,440	?
6. Welfare and relief	48,360	?
7. Schools	431,180	?
8. Debt service	388,695	?
9. Miscellaneous	12,480	?
Total	?	

1. What were the total estimated expenditures in this budget?

2. How much was this, on the average, for each person in the city? (Round off budget to $1,200,000.)

3. What per cent of the total spending was allotted to each item in the budget? (Before working the problem, round off each item to nearest thousand, total budget to $1,200,000.)

4. What two items combined account for about $\frac{2}{3}$ of the total budget?

5. Make a circle graph showing the amount allotted to the four largest items in the city budget. Put all the remaining items under the heading "Other Expenses."

★6. "Debt service" refers to interest which the community must pay on money borrowed, plus something put away each year to pay loans as they come due.

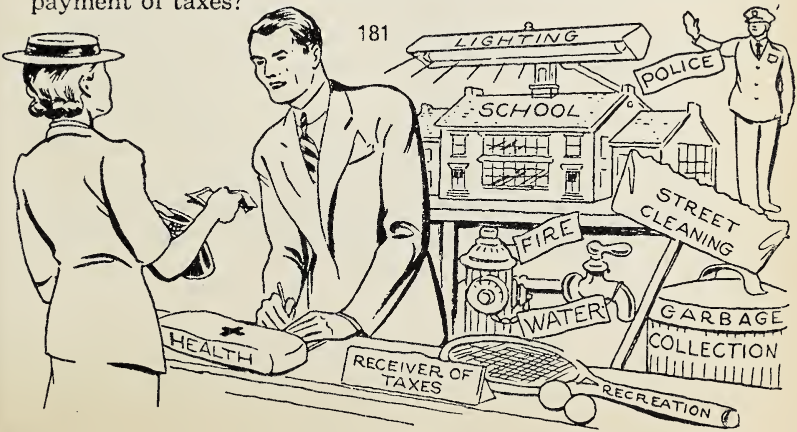
If $188,695 of the item, "Debt Service" represents interest paid on money borrowed at 3%, on the average, what is the city's debt (answer to nearest $1000)?

*7. What is meant by each item in the budget other than "debt service"?

*8. How do all citizens profit by each item in the budget?

*9. Do you have a private watchman for your home? "Certainly not," you say, but householders used to employ watchmen. Can police protection, fire prevention, and other community services be bought more cheaply by citizens as a group through taxes or by individuals privately?

*10. What two reasons, therefore, can you offer for the payment of taxes?



1. "This house," said Mr. Scott to John, "is worth $10,000; I would not take a cent less; and taxes aren't bad —$2\frac{1}{2}\%$ a year, or $150." John figured the taxes and decided that his father was wrong. What do you think?

2. "$150 is correct," continued Mr. Scott. "You figured on the price at which I am holding the house. But I pay taxes only on $6000, **the value placed on the property for tax purposes (assessed valuation)** by the city." Prove that Mr. Scott's tax bill is correct.

3. Use the Scott house as a sample and tell whether property usually is assessed at its true value; less than its true value; more than its true value.

4. How much must be raised by taxation in the city of 25,000 population (page 180)? If the assessed valuation of all property were $32,341,000, what was the tax rate?

$1,195,250 ÷ $32,341,000 = .0369 = 3.69%

The tax rate is 3.69% on $1; or 3.69¢ on $1.

RULE: **To find a tax rate, divide the amount to be raised by the total assessed valuation.**

5. Find the tax rate for the following:

	TO BE RAISED	ASSESSED VALUATION
a.	$ 25,000	$ 1,000,000
b.	1,000,000	50,000,000
c.	40,000	900,000
★*d.*	125,450	10,600,000

6. In one of the world's largest cities the assessed valuation of all lands and buildings (real propoerty or real estate) was about $17,000,000,000. If the taxes levied amounted to about $500,000,000, what was the tax rate?

EXPRESSING THE TAX RATE

Tax rates are usually expressed as so many mills on a dollar of assessed valuation (a mill is $\frac{1}{10}$¢); as so many dollars and cents on \$100 of assessed valuation; as so many dollars and cents on \$1000 of assessed valuation.

1. A tax rate is \$2.58 on \$100 of assessed valuation. How many mills on the dollar is this rate? How many dollars and cents on \$1000?

\$2.58 on \$100 is the same as 2.58¢ on \$1.

2.58 × 10 (mills in a cent) = 25.8 mills.

Thus, the tax rate may be written as 25.8 mills on \$1 of assessed valuation.

If the tax rate is \$2.58 for \$100 of assessed valuation, for \$1000 it will be ten times as much, or \$25.80.

2. How many mills are there in one dollar?

3. Express the following tax rates in mills on \$1: *a.* \$3.02 on \$100; *b.* \$19.31 on \$1000; *c.* \$2 on \$100.

4. Express the following tax rates in dollars and cents on \$1000: *a.* \$1.80 on \$100; *b.* 24.3 mills on \$1; *c.* 3.40 mills on \$1.

5. Express the following tax rates in dollars and cents on \$100: *a.* \$43.20 on \$1000; *b.* \$9.07 on \$1000.

*6. The school tax in a certain district was set at 27.5 mills. Express this tax on the basis of each \$100 of valuation; each \$1000.

*7. How much school tax (problem 6) would be paid by a man whose property is assessed at \$4600?

*8. A city fixed its tax rate at \$1.70 per \$100 valuation for city purposes, plus \$1.17½ for schools. An owner of two houses, assessed at \$5000 and \$3500, paid how much tax?

PROPERTY TAX

1. Mr. Dixon owns property assessed at $4600. If the tax rate is $3.18 on $100, what tax does he pay?

2. If Mr. Dixon pays his taxes (problem 1) in equal quarterly instalments, what is the amount of each instalment?

3. A city allows a discount of 2% on taxes paid in full on or before January 15 of any given tax year. If Mr. Green owns property assessed at $5400, and the city tax rate is $3.40 on $100, how much does he save by payment January 13?

4. A penalty of 8% was charged for failure to pay taxes when due. If Mr. Clayton's quarterly tax was $60, and he was 12 days late in paying one instalment, how much penalty had he to pay?

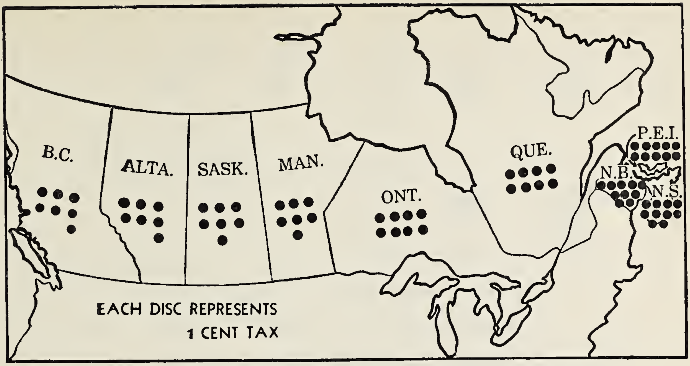
5. Mrs. Allen's property is assessed at $8400. Her school tax is 18 mills on $1. How much is her yearly school tax?

6. In a certain city taxes are payable October 1 and April 1. A discount of 4% is allowed on the second half-year's tax if paid when the first half is due and paid. The tax rate is $2.82 a $100 of assessed valuation. If I own a house, assessed at $10,000 in that city, and I pay my taxes in full October 1, how much do I pay?

7. The assessed valuations on Mr. Moore's two houses are $16,500 and $12,450. The school tax rate is 12.8 mills on $1. How much is his total yearly school tax?

8. Find the amount of property tax on the following:

	Assessed Valuation	Rate a $100		Assessed Valuation	Rate a $100
a.	$4650	$2.40	*d.*	$2125	$1.80
b.	3200	2.57	*e.*	5460	2.95
c.	6250	3.10	*f.*	3550	2.18



PROVINCIAL GASOLINE TAX RATES

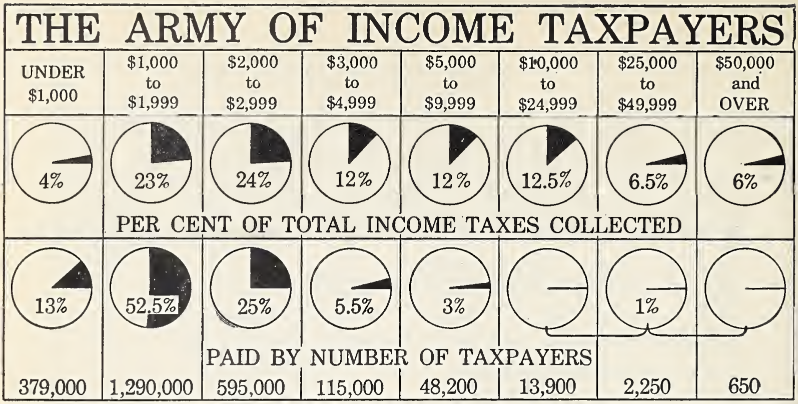
1. Check the map graph to see whether the rate as shown is the present tax in your province.

2. What provinces had a 10-cent tax on gasoline?

3. What provinces had a 7-cent tax on gasoline?

4. In the following table you are given the amount of motor fuel used in a year by provinces. Copy the table and insert the amounts received from the provincial gasoline tax.

Province	Gasoline Used	Provincial Tax
Prince Edward Island	7,900,000 gal.	
Nova Scotia	42,500,000 gal.	
New Brunswick	27,300,000 gal.	
Quebec	147,000,000 gal.	
Ontario	309,500,000 gal.	
Manitoba	63,400,000 gal.	
Saskatchewan	104,200,000 gal.	
Alberta	115,000,000 gal.	
British Columbia	86,900,000 gal.	



*DOMINION INCOME TAXES

1. How many persons paid income taxes for the year shown on the graph?

2. Which income group paid the greatest per cent of the total income tax? the smallest per cent?

3. The one group of taxpayers (problem 2) numbers about how many times as large as the other group?

4. What per cent of the taxpayers are included in the groups with incomes up to $5,000 a year?

5. What per cent of the total income tax do these 4 groups (problem 4) pay?

6. What per cent of the taxpayers are in the groups with incomes of $5,000 or more?

7. What per cent of the total income tax do these 4 groups (problem 6) pay?

8. Income taxes are based on "ability to pay." What does "ability to pay" mean?

9. How does the graph show that income taxes are based on ability to pay?

10. Find out how much of a single person's income is **exempt** from income tax? of a head of a family with 2 dependent children?

11. During one of the years of World War II the income tax rates on **taxable income** (total income less deductions and exemptions) were about as follows for single persons:

On the first	$ 500	37%
On the next	500	40%
On the next	1000	44%
On the next	1500	47%
On the next	1500	52%

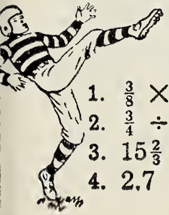
Using the above rates, find the income tax of a single person having a taxable income of $3600.

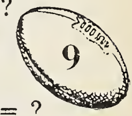
37% of $ 500 = ?, the tax on the first $ 500
40% of 500 = ?, the tax on the next 500
44% of 1000 = ?, the tax on the next 1000
47% of 1500 = ?, the tax on the next 1500
52% of 100 = ?, the tax on the remaining 100
? + ? + ? + ? = ?, the total tax.

12. Using the above rates, find the income tax of single persons having taxable incomes of: *a.* $950; *b.* $1800; *c.* $2250; *d.* $3300; *e.* $4800.

13. A married man computed his income tax according to the above rates, but was then allowed to deduct from the tax thus computed $150, plus $108 for each dependent child.

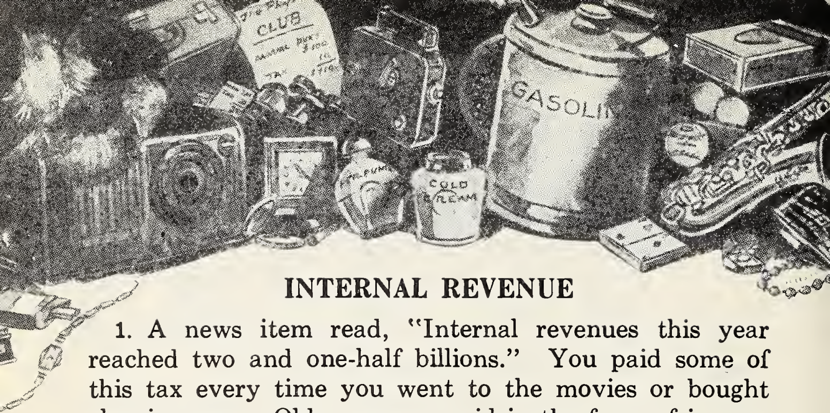
If Mr. Brown, a married man with 2 children, had a taxable income of $2800, what was his income tax?





LET'S PRACTISE

	a	*b*	*c*
1.	$\frac{3}{8} \times 42 = ?$	$5\frac{1}{2} \times 36 = ?$	$11\frac{1}{4} - 7\frac{5}{8} = ?$
2.	$\frac{3}{4} \div \frac{7}{8} = ?$	$12\frac{1}{2} \div 9 = ?$	$6\frac{1}{2} + \frac{3}{4} + \frac{5}{6} = ?$
3.	$15\frac{2}{3} - 8\frac{5}{6} = ?$	$36 \div \frac{4}{9} = ?$	$9.5 \times 4.3 = ?$
4.	$2.7 \div .03 = ?$	$.473 - .198 = ?$	$.51 \div .017 = ?$



INTERNAL REVENUE

1. A news item read, "Internal revenues this year reached two and one-half billions." You paid some of this tax every time you went to the movies or bought chewing gum. Older persons paid in the form of income taxes and taxes on gasoline, liquors, tobacco, radio sets, and dozens of other articles. How much, on the average, was paid (to the nearest 10¢) by each person in Canada (population 10,500,000)?

2. Certain brands of cigarettes were sold at 80¢ per package. The internal revenue tax on each package was 30¢. What per cent of the selling price was the tax?

3. During a recent year the tax on Canadian cigarettes was $6.00 per 1000. What did this amount to on a package of 20 cigarettes?

4. A box of cigars sold for $5.50. This price included a tax of 65¢. What per cent of the selling price was the tax?

5. A box containing two decks of playing cards sold for $1.60. This included an internal revenue tax of 20¢ on each deck. The tax was what per cent of the sale price?

6. During the years of World War II Canada levied a tax of 3¢ on each gallon of gasoline sold. What revenue was obtained from this source in a year when gasoline sales were 903,500,000 gallons?

★7. Find the rate of tax, if any, on *a.* telephone calls (long distance), *b.* railway tickets, *c.* matches.

CUSTOMS AND DUTIES

The Dominion Government raises large sums of money by taxes levied on commodities brought into the country. These are called import **duties.** Some countries levy export duties on certain things they export. Most countries levy **excise** taxes or duties on some articles produced or manufactured in the country.

Import and export duties are payable at a **Customs House**: excise duties are payable at an **Inland Revenue Office.**

For the purpose of duty, goods or commodities may be divided into four classes:

(1) Those that are admitted free, that is, without duty of any kind.

(2) Those that are subject to an **ad valorem** duty, that is, a tax of a certain per cent of their invoiced value.

(3) Those subject to a **specific** duty, that is, a certain amount a pound, a yard, a piece, etc., without reference to the value.

(4) Those subject to both an ad valorem and a specific duty.

1. Find the ad valorem duty on a rug valued at $50, if the duty is 30% of its invoice value.

2. Find the specific duty on a ton of cheese, if the duty is $7.00 per 100 pounds.

3. Find the total duty on 100 pounds of wool yarn, valued at $1.80 a pound, if the specific duty is 20 cents a pound, and the ad valorem duty is 20%.

4. Find the total excise duty on 1,575 pounds of tobacco, if the tax is 2 cents an ounce.

THE MEANING OF TARIFF

A list of goods with their duties is called a **tariff.**

At present goods manufactured in most parts of the British Empire have smaller duties when imported into Canada than those paid by most other countries. Some countries because of special treaties also pay duties, called **intermediate,** smaller than those included in the **general** tariff.

The table below shows the Canadian tariff rates on certain commodities in effect January 1, 1936. Since these rates change from time to time, the rates to-day may not be the same as those given below.

On January 1, 1936 a new Canada-United States trade pact came into force. The United States now, with 22 other countries, enjoys Canada's most favoured nation treatment. Where the general tariff has heretofore applied, the intermediate will now apply.

	British Preferential	Intermediate	General
Automobiles	Free	17½%	27½%
Apples	Free	15%	20%
Carpets (Turkish)	5¢ a sq. ft. and 30%	15¢ a sq. ft. and 35%	20¢ a sq. ft. and 40%
Leather gloves	25%	25%	45%
Mowers	Free	15%	25%
Petroleum (crude)	⅓¢ a gal.	½¢ a gal.	1¢ a gal.
Starch	1¢ a lb.	2¢ a lb.	2¢ a lb.
Sugar	$.83 a cwt.	$1.00 a cwt.	$1.50 a cwt.
Wool yarn	11¼¢ a lb. and 15%	20¢ a lb. and 20%	22½¢ a lb. and 22½%

1. Name the three tariffs given in the table on page 190.

2. Which articles are without duty in one or more of the tariffs?

3. On which items is there only an ad valorem duty?

4. On which items is there only a specific duty?

5. On which items are there both specific and ad valorem duties?

Using the rates given in the table on page 190 find the intermediate duty on the following:

6. An automobile invoiced at $1,000.

7. 250 bbl. of apples, invoiced at $3.00 a bbl.

8. 4 doz. leather gloves, invoiced at $10 a doz.

9. 15,000 gal. of crude petroleum.

10. 6,000 lb. of sugar.

11. A $200 Turkish rug, 10 ft. by 12 ft.

12. 200 lb. of wool yarn, invoiced at $1.50 a lb.

13. Find the general duty on a shipment of 50 mowers, invoiced at $7.20 each. Find also the total cost of the mowers to the importer.

14. How much less than the general duty is the British preferential duty on a shipment of 1,800 pounds of starch?

15. How much less than the intermediate duty is the British preferential duty on a $750 automobile?

16. How much will be saved by importing from England an 8′ x 10′ Turkish rug, invoiced at $75, instead of from some country which pays intermediate tariff rates?

17. A dealer imported leather gloves from England, invoiced at $120. He paid the duty, and then sold all of the gloves for $200. What per cent of the selling price was the gain?

USING THE VOCABULARY OF ARITHMETIC

Define each of the following terms or use it correctly in a sentence. If you do not know the meaning of a term, turn to the key page in parentheses.

ad valorem duty	(189)	internal revenue	(188)
assessed valuation	(182)	mill	(183)
budget	(178)	property tax	(182)
customs duties	(189)	real estate	(182)
customs house	(189)	specific duty	(189)
exemption	(186)	tariff	(190)
excise tax	(189)	taxable income	(187)
import duty	(189)	taxes	(180)
income tax	(186)	tax rate	(182)
taxpayer	(180)		

*TOPICS FOR SPECIAL REPORTS

1. "Nuisance taxes."
2. Free trade—advantages and disadvantages.
3. The budget of our local government.
4. What I get for my taxes from Canada, my province, my community.
5. The national debt.
6. Taxes should be based on **ability** to pay.
7. Taxes should be based on **benefits derived.**
8. Taxes (at least 3) for the support of our local community.
9. Taxes (at least 3) for the support of our provincial government.
10. Taxes (at least 3) for the support of our national government.

MAGIC SQUARES

Draw three squares each containing 16 cells. Copy the numbers given and then find the missing numbers in each magic square.

13	?	?	23
?	22	14	9
21	?	12	15
11	16	?	6

$1\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{4}$	?
$\frac{5}{12}$	?	$\frac{5}{6}$	$\frac{2}{3}$
$\frac{3}{4}$	?	$\frac{1}{2}$	?
$\frac{1}{3}$	$1\frac{1}{6}$	$1\frac{1}{4}$	?

8.0	?	1.5	6.5
2.5	5.5	?	?
4.5	3.5	?	6.0
2.0	?	7.5	0.5

LET'S PRACTISE

Set I

	a	*b*	*c*
1.	$4020 - 2026 = ?$	$14 \times 4\frac{5}{6} = ?$	$3 \div 2\frac{1}{2} = ?$
2.	$7826 \div 18 = ?$	$4\frac{1}{6} - 2\frac{2}{3} = ?$	$5\frac{1}{2} \times 4\frac{3}{4} = ?$
3.	$6.7 \times 30.8 = ?$	$319.2 \div .38 = ?$	$16.05 - 9.95 = ?$
4.	$9\frac{3}{4} \div 12\frac{3}{8} = ?$	$21\frac{3}{8} \times 12 = ?$	$16 \div \frac{8}{9} = ?$

5. $9\frac{3}{8} + 7\frac{1}{2} + 12\frac{3}{4} + 11\frac{7}{8} + 15 + 6\frac{1}{4} = ?$

6. $.738 + .095 + .600 + .498 + .675 + .846 = ?$

Set II

	a	*b*	*c*
1.	3% of 145 = ?	$\frac{1}{2}$% of 480 = ?	175% of 54 = ?
2.	12 = ?% of 48	60 = ?% of 24	96 = ?% of 480
3.	75% more than 60 = ?	90% less than 150 = ?	1% more than 200 = ?
4.	$\frac{1}{2}$% of 940 = ?	100% of 7.5 = ?	1.6% of 55 = ?
★5.	8 = 4% of ?	24 = 20% of ?	36 = 150% of ?
★6.	103% of 750 = ?	27 = ?% of 18	30 = 15% of ?

HOW WELL DO YOU REMEMBER?

1. In 1901 the net debt per capita in Canada was $50; in 1941 (the year of the last Dominion Census), $317.

a. The debt in 1941 was how many times as much as in 1901?

b. How much was the debt in 1941 (assume the population at 11,500,000)?

2. If the average provincial tax on gasoline is 8¢ a gallon, how much tax will Mr. Average Motorist pay if he gets 20 miles to the gallon and drives 7500 miles?

3. About 25.3¢ of each rent dollar represents hidden taxes. If the Jones family pays $60 a month rent, how much hidden tax do they pay in a month? in a year?

4. A farm neighbourhood of 400 people had property assessed at $200,000. If the expenses of local government averaged $5000 a year, what was the tax rate in mills on a dollar? in dollars on each $100 of assessed valuation?

5. In one Canadian city the tax rate for schools is $1.17½ for each $100 of assessed valuation. A manufacturer in that city has a factory assessed at $250,000. How much school tax does he pay?

6. The budget of that city for one year was $8,000,000. Of this amount, $6,000,000 came from taxes on real estate; $500,000 from licenses and business taxes; $1,000,000 from light and water rates; $300,000 from sale of city lands; and the remainder from several other sources.

a. Show these figures by a circle graph.

b. What per cent of the budget was supplied by taxes on real estate?

THINGS TO REMEMBER

1. *How a tax rate is determined.*
2. *How to express a tax rate.*
3. *Types of local, provincial and Dominion taxes.*
4. *The difference between direct and indirect taxes.*

TEST ON CHAPTER VIII

1. A tax rate of 23.4 mills on $1 of assessed valuation is how many dollars on $100 of assessed valuation? on $1000?

2. A school tax rate is 12 mills on $1 of assessed valuation. Find the amount of school taxes which a man will pay whose property is assessed at $4600.

3. Mr. Hanson paid $9500 for his property. It is assessed at 60% of this value. Find his yearly tax if the rate is $2.87 on $100 of assessed valuation.

4. Mr. Fisher, a single man, has a taxable income of $3,000 on which he pays income tax at the rates shown on page 187. Find the amount of his tax.

5. Certain college students decided to pay one fourth of their purchases in pennies. These pennies, so they claimed, represent the hidden tax on the article. If a student bought a suit of clothes for $36, what was the hidden tax?

6. The price of gasoline, posted at a gasoline station, was: gas, 31¢; provincial tax, 7¢. What was the total cost of the gasoline a gallon? To the nearest tenth per cent, the tax was what per cent of the selling price?

7. If a motorist drives 9600 miles in one year and averages 20 miles to a gallon of gasoline, find the gasoline tax he paid at the rate of 7¢ a gallon.

8. Tickets to a professional hockey game averaged $1.00 each plus a tax of 10%. What was the total tax on a sale of 12,840 tickets?

PROGRESS TEST

Solve the following problems. Then have your paper scored. If you made errors, turn to the key page in parentheses where the work is illustrated and explained.

1. In a high school 876 pupils spent $27,000 for "sweets" in one school year. To the nearest cent, what was the average amount spent for sweets by each pupil? (27)

2. Find the area of a square having a perimeter of 24 inches. (38)

3. The side of an equilateral triangle is 8 feet and its altitude is 6.9 feet. What is the area of the triangle? (40)

4. A one-way bus ticket cost 40¢, or 65¢ a round trip. What per cent of the cost of two one-way tickets may be saved by buying a round-trip ticket? (82)

5. What is the date of maturity of a 60-day note drawn on April 17? (119)

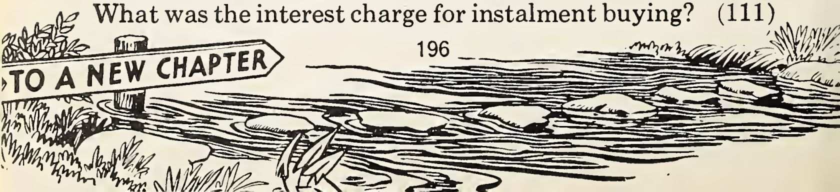
6. Find the value at maturity of a 90-day note for $800, bearing interest at 6%. (115)

7. A property, worth $4800, is mortgaged for 60% of its value. Find the amount of the mortgage. What is the yearly interest on the mortgage at $5\frac{1}{2}$%? (137)

8. A school district, having an assessed valuation of $360,000, sets its budget at $6480. What rate of taxation will be required to meet this budget *a.* in mills; *b.* in dollars per $100? (182)

*9. An agent earned $27.20 a week (on the average) selling toilet articles. If his commission was 40%, what were his average weekly sales? (74)

*10. An electric washing machine sold for $65 cash, or $5 down and $8 a month for 8 months. What was the interest charge for instalment buying? (111)



CHAPTER IX

THE GRAIN TRADE AND FARM PROBLEMS

In the early settlement days in Western Canada grain was handled in bags and moved by ox-carts. With the construction of railroads, country elevators were erected which made possible the handling of grain in bulk.

The first grain elevator was built in 1881. Since then over 5500 have been built. From these country elevators, grain is carried to terminal elevators at Fort William and Port Arthur, Vancouver and Churchill. The terminal elevators at Port Arthur and Fort William have a capacity of approximately 174,000,000 bushels; those on the Pacific Coast 21,500,000 bushels; and the elevator at Churchill 2,500,000 bushels.

1. How many years ago is it since the first elevator was built in Western Canada?

2. What is the total capacity of the terminal elevators in the ports mentioned above?

3. If in a recent year each country elevator handled approximately 130,000 bushels, what was the total amount handled by all the country elevators?

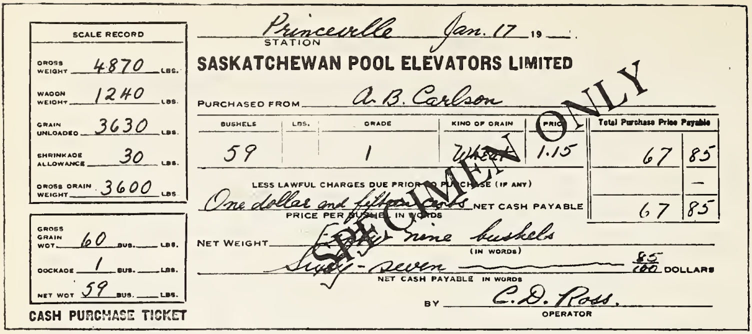
The following are the weights of various grains per bushel:

Wheat 60 lb.; oats 34 lb.; barley 48 lb.; rye 56 lb.; and flax 56 lb.

4. How many bushels of wheat are there in a load, if the net weight of the wheat is 4830 lb.?

5. What would be the gross weight of a wagon loaded with 65 bushels of rye if the wagon weighed 1245 lb.?

6. What would be the value of the above load if rye is worth $2.45 a bushel?



SCALE RECORD

GROSS WEIGHT 4870 LBS.

WAGON WEIGHT 1240 LBS.

GRAIN UNLOADED 3630 LBS.

SHRINKAGE ALLOWANCE 30 LBS.

GROSS GRAIN WEIGHT 3600 LBS.

GROSS GRAIN WGT. 60 BUS. LBS.

DOCKAGE 1 BUS. LBS.

NET WGT 59 BUS. LBS.

CASH PURCHASE TICKET

Princeville STATION Jan. 17 19

SASKATCHEWAN POOL ELEVATORS LIMITED

PURCHASED FROM A. B. Carlson

BUSHELS	LBS.	GRADE	KIND OF GRAIN	PRICE	Total Purchase Price Payable	
59		1	Wheat	1.15	67	85
		LESS LAWFUL CHARGES DUE PRIOR TO PURCHASE (IF ANY)				—
		NET CASH PAYABLE			67	85

One dollar and fifteen cents PRICE PER BUSHEL IN WORDS

NET WEIGHT Fifty nine bushels (IN WORDS)

Sixty-seven $\frac{85}{100}$ DOLLARS NET CASH PAYABLE IN WORDS

BY C. D. Ross. OPERATOR

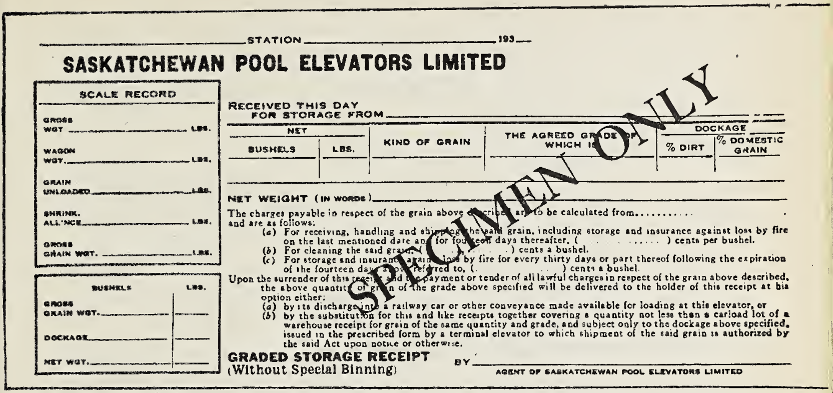
SPECIMEN ONLY

The elevator agent may give the farmer a **cash ticket** as shown above, stating the weights, grade, price, etc. Cash tickets may be turned in at face value in banks, stores, or other places of business. As there is a certain amount of moisture in all grain a deduction is made by the agent and this is called **shrinkage** allowance. A deduction is also made for any type of foreign material such as weed seeds, other grains, etc., and this is termed **dockage**.

1. When was the ticket written? Where?
2. What was the shrinkage allowance?
3. How great a deduction was made for dockage?
4. What grade was given by the agent?
5. What price a bushel was paid for the wheat?
6. What was the amount of the ticket?
7. Who was the agent at the country elevator?

8. Henry Thompson took a load of wheat to the elevator at Morton and the agent graded it No. 2, at $1.12 a bushel. The gross weight of the load was 4663 pounds. The wagon weight was found to be 1226 pounds.

The allowance for shrinkage was 17 pounds, and the dockage was 1½ bushels. Write Mr. Thompson's ticket.



STATION 193

SASKATCHEWAN POOL ELEVATORS LIMITED

SPECIMEN ONLY

SCALE RECORD

GROSS WGT LBS.

WAGON WGT. LBS.

GRAIN UNLOADED LBS.

SHRINK. ALL'NCE LBS.

GROSS GRAIN WGT. LBS.

	BUSHELS	LBS.
GROSS GRAIN WGT.		
DOCKAGE		
NET WGT.		

RECEIVED THIS DAY FOR STORAGE FROM

NET		KIND OF GRAIN	THE AGREED GRADE OF WHICH IS	DOCKAGE	
BUSHELS	LBS.			% DIRT	% DOMESTIC GRAIN

NET WEIGHT (IN WORDS)

The charges payable in respect of the grain above described are to be calculated from.......... and are as follows:
(a) For receiving, handling and shipping the said grain, including storage and insurance against loss by fire on the last mentioned date and for fourteen days thereafter, ( ) cents per bushel.
(b) For cleaning the said grain, ( ) cents a bushel.
(c) For storage and insurance against loss by fire for every thirty days or part thereof following the expiration of the fourteen days above referred to, ( ) cents a bushel.
Upon the surrender of this receipt and the payment or tender of all lawful charges in respect of the grain above described, the above quantity of grain of the grade above specified will be delivered to the holder of this receipt at his option either:
(a) by its discharge into a railway car or other conveyance made available for loading at this elevator, or
(b) by the substitution for this and like receipts together covering a quantity not less than a carload lot of a warehouse receipt for grain of the same quantity and grade, and subject only to the dockage above specified, issued in the prescribed form by a terminal elevator to which shipment of the said grain is authorized by the said Act upon notice or otherwise.

GRADED STORAGE RECEIPT
(Without Special Binning)

BY
AGENT OF SASKATCHEWAN POOL ELEVATORS LIMITED

A farmer may request the agent to store his grain until the price is more favourable. He will then receive a graded storage receipt like the one shown above. The elevator charges $1\frac{3}{4}$ cents a bushel for handling the grain, and storing it for fifteen days. A charge of $\frac{1}{45}$ cent a bushel a day is then made.

1. What will be the charge for handling, and storing 1360 bushels of wheat for 60 days?

2. Find the handling and storage charges on 1600 bushels of wheat from October 10 until April 23.

3. Which is the more profitable, to sell grain outright on October 1 at $1.10 a bushel, or to store it until January 13 and then sell it at $1.30 a bushel? What is the difference a bushel?

4. What are the storage and handling charges on 1250 bushels of rye brought to the elevator on September 3 and sold on December 2?

FARM PROBLEMS

1. At 25¢ a hundredweight, what would be the freight charge on 1600 bushels of oats? of barley?

2. $2\frac{1}{2}$ lb. of Atlacide on 100 sq. ft., kills the roots of Canada thistle. How much Atlacide is required to kill a patch of Canada thistle covering 1260 sq. ft.?

3. A farmers' co-operative bought the following: coal $7,625, binder twine $1,650, fertilizer $9,450, fencing $7,200. Find the total amount of these purchases?

4. The co-operative received the following discounts: coal, 5%; binder twine, 10%, fertilizer, $7\frac{1}{2}$%, and fencing, $12\frac{1}{2}$%. How much was saved by these discounts?

5. A farmer living where the hail insurance rate is 5%, insured his wheat crop of 320 acres for $10 an acre. During the summer his crop was damaged to the extent of 40% by hail. How much insurance may he collect?

6. What is the tax on a half-section of land assessed at $30 an acre if the tax rate is 24 mills on the dollar?

7. How many pounds of butter fat would there be in 3500 lb. of milk testing 3.75% butter fat?

8. A farmer has a half-section of wheat which will require approximately $2\frac{1}{3}$ lb. of twine an acre. If twine costs $15\frac{1}{2}$¢ a lb., how much will the farmer pay for sufficient twine to tie the crop?

9. A Manitoba farmer harvested 24.5 bushels an acre from a wheat field which had not been fertilized and 36.5 bushels an acre from one on which he had put fertilizer. The fertilized field yielded what per cent more than the unfertilized field?

10. A cow produced 3931.6 lb. of milk in one year. How many quarts was this? (1 qt. of milk = 2.58 lb.)? What was the total value of the milk, at 8¢ a quart?

USING THE VOCABULARY OF ARITHMETIC

Use correctly in a sentence or give the meaning of each of the following terms. If you do not know the meaning of any term, refer to the key page in parentheses.

cash ticket	(198)	handling charges	(199)
dockage	(198)	net weight	(198)
elevator capacity	(197)	shrinkage	(198)
graded storage receipt	(199)	storage rates	(199)
gross weight	(198)	terminal elevators	(197)

TOPICS FOR SPECIAL REPORTS

1. How is grain unloaded at a country elevator? Are wagons or trucks most commonly used now for hauling grain?

2. Ask an elevator man what is meant by a "special bin receipt." Of what value to the farmer is this particular means of storing grain?

3. Why is there such limited storage space in the terminal elevator at Churchill? Why is most of the grain sent by rail only as far as Fort William and Port Arthur instead of continuing by rail to Montreal?

4. What is the difference between Pool Elevators and Line Elevators? How many Pools are organized for the marketing of grain in the Prairie Provinces?

5. In the movement of grain the railroads are called upon to perform an enormous seasonal task. When is this movement at its peak? What rates are charged for freighting grain from your locality?

6. Make a circle graph showing the percentage of wheat used in Canada and the percentage exported.

7. What other countries produce wheat for world markets?

8. What is meant by No. 1 Manitoba Hard wheat?

THINGS TO REMEMBER

1. *How to find handling and storage charges.*

2. *The weights of the various grains a bushel.*

3. *How to use shrinkage and dockage in finding the net weight of grain.*

4. *Value of a bushel of wheat depends on the market price and the grade given to the farmer.*

TEST ON CHAPTER IX

1. Find the value of 120 bushels of wheat at $1.20 a bushel if the dockage is 2%.

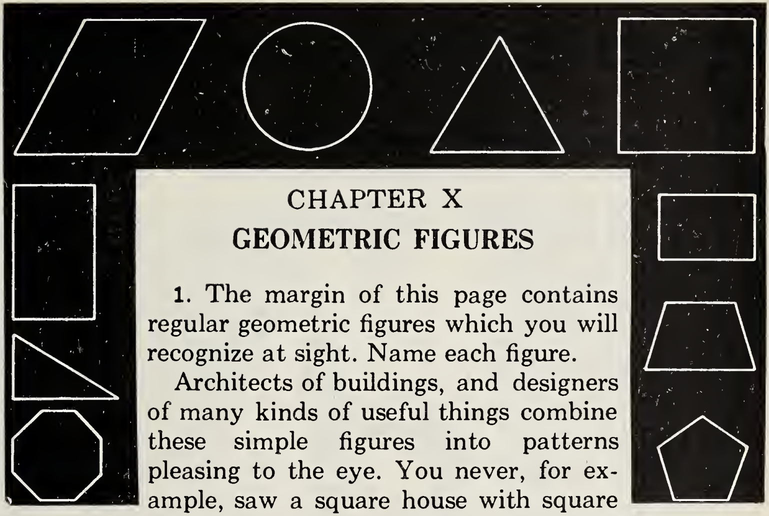
2. Which gives the greater profit (*a*) to sell grain without storage on October 10 at 80 cents, or, (*b*) to store it from that date to January 8 and sell it at $1.10, paying freight at 19 cents a bushel, storage charges, and 1 cent a bushel selling commission? What is the difference?

3. A flour mill gives in exchange for 60 lb. of No. 1 wheat 37 lb. of flour, 18 lb. of bran, and 5 lb. of shorts. How many lb. of the above products will a farmer receive from 50 bushels of No. 1 wheat, assuming the dockage to be 2%?

4. Find the value of a load of wheat, given the following information: Gross weight, 5875 lb.; wagon weight, 1475 lb.; shrinkage, 10 lb.; dockage 40 lb.; price $1.05 a bushel.

5. If one pound of butterfat makes 1.2 pounds of butter, how many pounds of butter can be made from 150 pounds of butterfat?

6. A farmer sells 58 bushels of barley to the elevator. If the shrinkage was 12 lb. and the dockage taken was 2 bushels 24 lb., what was the net weight and the value of the grain, if it sold for 45 cents a bushel?



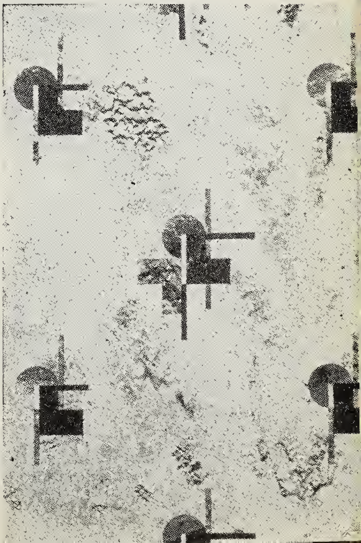
CHAPTER X

GEOMETRIC FIGURES

1. The margin of this page contains regular geometric figures which you will recognize at sight. Name each figure.

Architects of buildings, and designers of many kinds of useful things combine these simple figures into patterns pleasing to the eye. You never, for example, saw a square house with square windows and square doors. People dislike this sameness. They demand at least a few rectangles for openings.

2. Notice how pleasing is the design of the floor covering. Name each geometric figure which you recognize in this pattern.



3. Plan a "geometric figure hunt" similar to the "scavenger hunts" of which you are so fond. Bring in examples of not less than 12 geometric figures used in designs. (HINTS: clothing, furniture, buildings, objects in nature, jewellery.)

*4. Plato, a Greek, and one of the most learned men of all time, said, "God eternally geometrizes." What did Plato mean?

GEOMETRY: AIR—SEA—LAND

SEGMENTS—ANGLES—BISECTORS—PERPENDICULARS

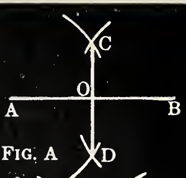


FIG. A

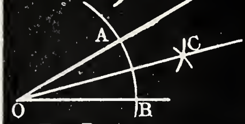


FIG. B

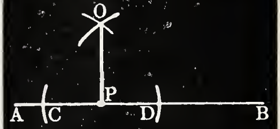


FIG. C

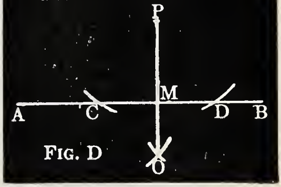


FIG. D

You have learned how to bisect a line (Fig. A); how to bisect an angle (Fig. B); and how to construct a perpendicular from a point on a line (Fig. C).

1. Tell briefly:
   a. What **bisect** means.
   b. What a **segment** of a line is.
   c. Whether a line is of **definite** or **indefinite** length.
   d. When two lines are **perpendicular** to each other.
   e. How to bisect a line.
   f. How to bisect an angle.
   g. How to erect a perpendicular.

2. Draw a line 5 inches long and bisect it. Test the accuracy of your construction with your compasses.

3. Draw an angle of 50° and bisect it. Test the accuracy of your construction with your protractor.

4. How can you divide a line or an angle into 4 equal parts?

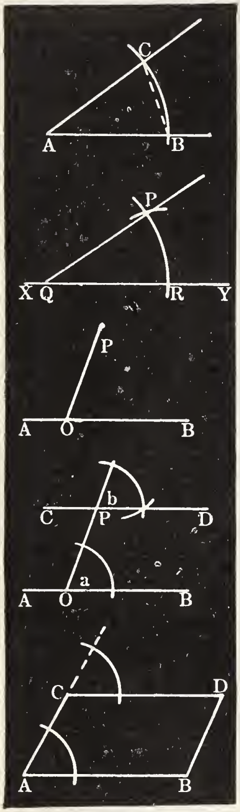
5. Draw a line, AB, 3 inches in length. At a point, 1 inch from A, erect a perpendicular. How many degrees are in each angle at A? Measure each angle with a protractor.

6. Figure D shows the construction of a perpendicular to a line from a point outside the line. Tell each step in the construction.

7. From a point, P, outside a line, AB, construct a perpendicular to the line.

*8. Draw an isosceles triangle and bisect the base. The bisector should also bisect the vertex. Prove that it does.

PARALLEL LINES—HOW CONSTRUCTED



1. One of your important jobs this school year is to prove that you can construct a line parallel to a given line. When are two lines said to be **parallel**?

2. Your first task is to construct an angle, *PQR*, equal to another angle, *CAB* (∠ is the symbol for angle).

a. Tell how ∠ *PQR* was constructed.

b. Draw any angle. Construct another angle equal to it.

3. Your second task is to construct a line at point, *P*, parallel to *AB*. The given line is *AB*.

a. Draw a line from *O* through *P*.

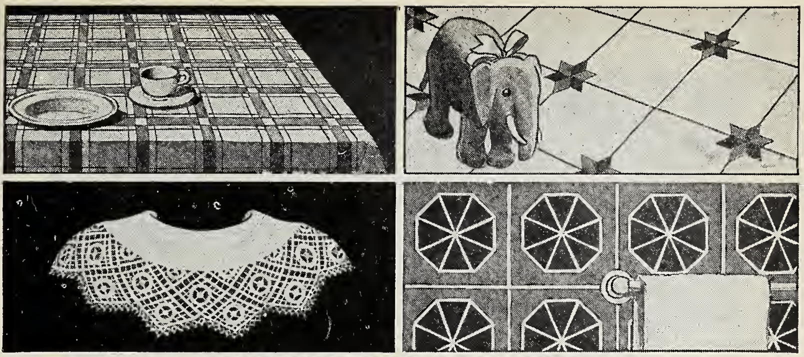
b. Construct at point, *P*, angle *b* equal to angle *a*.

c. The side of this angle *CD* is parallel to *AB*.

d. Draw any straight line. Construct another line parallel to it. Check with your ruler or by dots on paper to find whether the two lines are equally distant at all points.

4. Draw an angle of 40°. With ruler and compasses, construct an angle of 40°. Test the accuracy of your construction with your protractor.

*5. Draw lines *AB* and *AC* of any length. At *C* construct a line parallel to *AB*. Mark point, *D*, on this line at the same distance from *C* that *B* is from *A*. Join *DB*. What kind of geometric figure have you constructed?



BUSINESS USES GEOMETRY

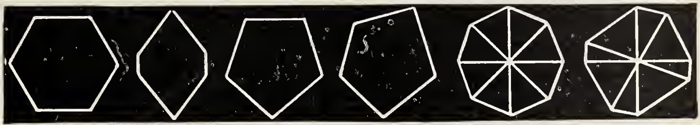
1. On this page are designs for table oilcloth, floor linoleum, embroidery, and bathroom tile. Martha noted the geometric figures in each design and remarked, "Business also eternally geometrizes." What did she mean?

2. Name each geometric figure in these designs.

3. Choose one of the simpler designs illustrated and construct it; or choose a design used in the furnishings of your home.

4. *a.* How many sides has a square?
   b. Are the sides equal or unequal in length?
   c. Are the 4 angles equal or unequal?

5. Any plane figure bounded by straight lines is a **polygon.** If the sides are of equal length and the angles are equal in size, the figure is a **regular polygon.**



a. Why are all these figures polygons?

b. Which figure is a regular pentagon? How many equal sides? equal angles?

c. A regular hexagon? How many equal sides? angles?

d. A regular octagon? How many equal sides? angles?

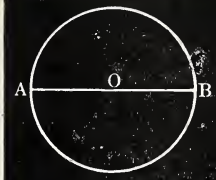


FIG. A

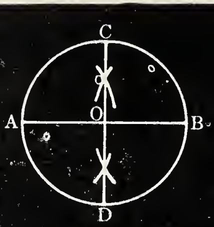


FIG. B

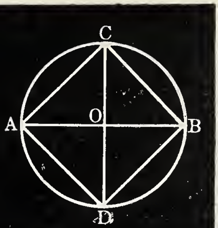


FIG. C

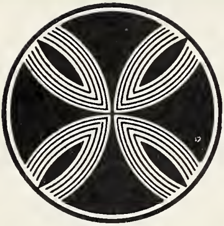


FIG. D

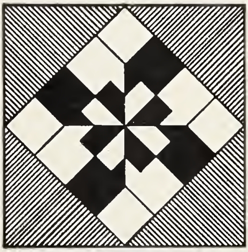


FIG. E

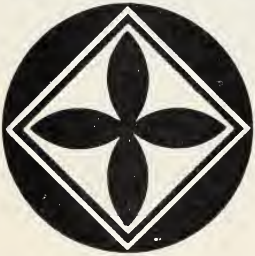


FIG. F

THE INSCRIBED SQUARE

1. Draw a circle with any given radius.

2. Draw any diameter to your circle, such as *AOB*.

3. Construct a second diameter, such as *COD*, perpendicular to the first.

4. Connect with straight lines the points *AC*; *CB*; *BD*; *DA*.

5. What geometric figure have you constructed? This square is said to be **inscribed in the circle.** Why?

6. Construct Figure D, based on the circle.

7. Construct Figure E, based on the square.

8. Construct Figure F, based on the inscribed square.

*9. Construct a regular inscribed **octagon.** (HINT: The sides of the inscribed square must be bisected.)

THE BEE KNOWS HIS GEOMETRY

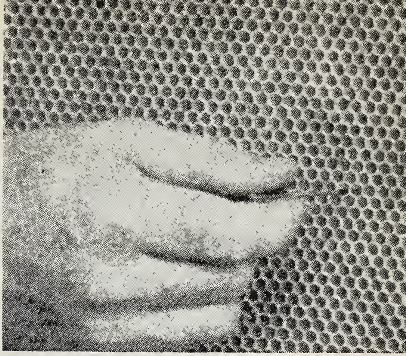


FIG. A

1. Here is part of a honeycomb.

a. How many sides has each cell?

b. What name is given to a 6-sided plane figure?

c. If each side were the same length and each angle of equal size, what kind of hexagon would be formed?

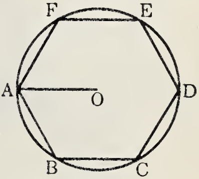


FIG. B

2. Figure B is a regular inscribed hexagon. Measure with your compasses radius *OA*. How does *OA* compare in length with any side of the hexagon?

3. Tell how to inscribe a hexagon in a circle using compasses or ruler.

4. Construct a regular inscribed hexagon, *ABCDEF*, with sides 2 inches long.

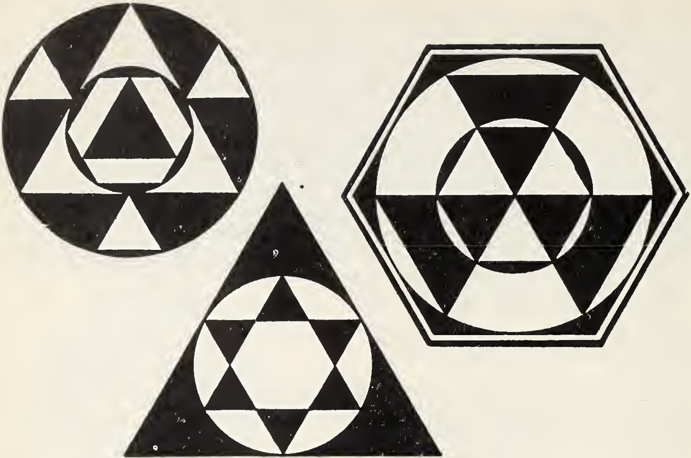
5. Connect points *B* and *C* with the centre of the circle. What kind of a triangle is formed?

6. How many diagonals can be drawn from each vertex of a hexagon?

7. In the figure which you constructed (problem 4), draw diagonal *AD*. What kind of geometric figure is each half of the hexagon?

8. An equilateral triangle may be formed by connecting alternate vertices of a hexagon. Construct an equilateral triangle by this method.

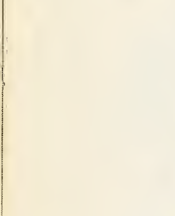
★9. Tell how to construct a figure of twelve equal sides. Construct such a figure.

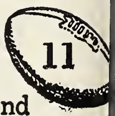


CIRCLE, TRIANGLE, AND HEXAGON

1. Construct two designs selected from those shown above. (Each design, as you see, requires for its construction some knowledge of circle, triangle, and hexagon.)

*2. Construct an original design based on the circle, triangle, and hexagon.



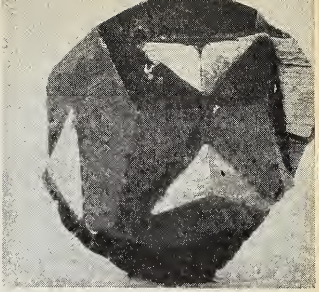


LET'S PRACTISE

Add the examples in the first row; subtract in the second row.

	a	*b*	*c*	*d*	*e*	*f*
1.	$\frac{3}{8}$ $\frac{3}{4}$ $\frac{1}{2}$	$\frac{5}{6}$ $\frac{2}{3}$ $\frac{1}{2}$	$\frac{7}{16}$ $\frac{3}{8}$ $\frac{3}{4}$	$7\frac{3}{4}$ $6\frac{5}{8}$ $\frac{1}{2}$	$4\frac{7}{8}$ $9\frac{5}{6}$ $7\frac{3}{4}$	$8\frac{7}{12}$ $6\frac{3}{4}$ $1\frac{1}{3}$
2.	$\frac{5}{8}$ $\frac{1}{2}$	$\frac{11}{12}$ $\frac{3}{4}$	96 $58\frac{3}{8}$	$42\frac{1}{2}$ $13\frac{3}{4}$	$24\frac{1}{3}$ $17\frac{5}{6}$	$82\frac{1}{4}$ $34\frac{5}{6}$

FIVE SIDES—FIVE POINTS—FIVE ANGLES

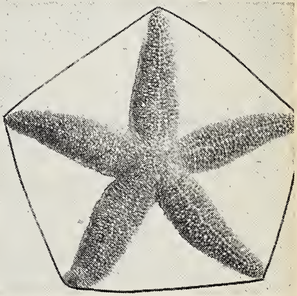


Pyrite is a kind of rock containing sulphur and iron. Almost perfect crystals of pyrite (Fig. A) are found.

1. How many sides has each black face of this crystal?

2. What name is given to any 5-sided plane figure?

3. If each side of the face of the crystal were of equal length and the 5 angles of equal size, what kind of pentagon would be formed?



4. The starfish has a fishing line caught between each pair of its arms. What kind of figure does the line make?

5. What kind of figure would be formed between the line and each pair of arms?

6. Figure C is a regular inscribed pentagon. Copy it as follows:

   a. Draw a circle with any radius.

   b. At centre, *O*, draw an angle of 72° (360 ÷ 5 = 72°) and extend its sides to cut the circle.

   c. Lay off 5 points on the circle the same distance apart as are the ends of the 2 radii.

   d. Connect these points.

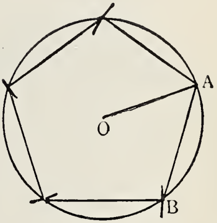


Fig. C

7. Draw a 5-pointed star; a 10-pointed star.

8. Draw this design.

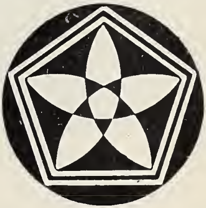


Fig. D

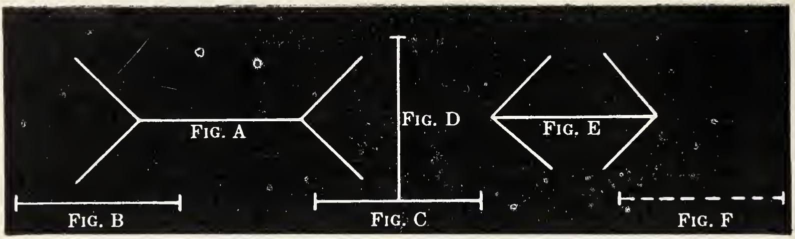


Fig. A

Fig. B

Fig. C

Fig. D

Fig. E

Fig. F

BELIEVE IT OR NOT

1. **"Believe it or not,"** all of the lines in Figures A, B, C, D, E, and F are of the same length. Prove by measurement.

2. **"Believe it or not,"** the pairs of vertical lines (**Figs.** H, I) are parallel. Prove by use of any straight edge.

3. **"Believe it or not,"** Figure G is constructed only of straight lines. Try to find a curved line in the figure.

★4. **"Believe it or not,"** a circle is sometimes called a **regular polygon with an infinite number of sides.** How does Figure G help you to understand this statement?

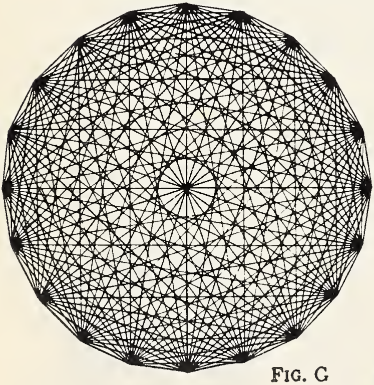


Fig. G

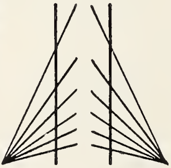


Fig. H

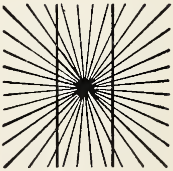


Fig. I

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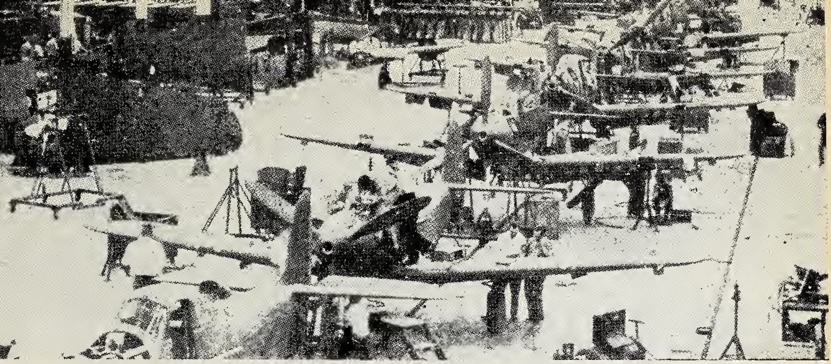
[1] Used by special permission of Robert "Believe-it-or-not" Ripley.



MORE GOODS—LESS COST

"Run down to the service station and get me a new hub cap for the car," said Mr. Scott to Frank, "and while you are about it, bring along a couple of spark plugs."

1. When the new hub cap was sprung on the wheel and the plugs screwed into place, they fitted as snugly as the parts which came with the car. Why?

2. Mr. Scott smashed a fender. Must he have a new fender built to his order or can he buy one ready-made? Why?

Articles exactly alike in size and form are said to **coincide** and to be **congruent.**

3. Name 5 objects which are **congruent** or **coincide** from each of the following groups of useful things.

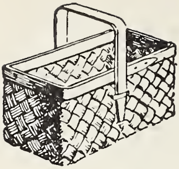
a. Furniture and house furnishings
b. Clothing
c. Sporting goods
d. Jewellery
e. Automobile parts

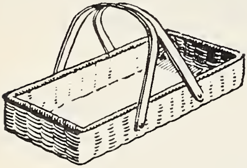
4. How does the use of congruent parts keep down the cost of each part? increase the speed of production?

*5. How may the wider use of congruent parts increase the need for machines? decrease the need for workers?

*6. What is meant by standardization in industry?

EQUIVALENT OR CONGRUENT





1. *a.* Here are two market baskets. Why are they not congruent?

b. Might they be **equivalent,** that is, of equal size? Why?

2. Under what condition would two bushel baskets be congruent? equivalent?

3. If two auto fenders are congruent, are they necessarily equivalent? Explain.

4. If two chocolate bars are equivalent in weight, are they necessarily congruent? Explain.

5. If the sides of each of two equilateral triangles are 3 inches, are the triangles equivalent? congruent? Why?

6. Two cans each hold exactly 1 gallon, the base of each is a square 5 inches on a side, and each side of the cans is a rectangle. Are the cans congruent? Explain.

*7. If two isosceles triangles have equal bases and equal altitudes, are they equivalent? congruent? Explain.

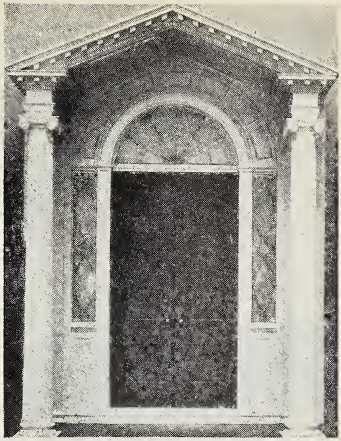
*8. If any two triangles have equal bases and equal altitudes, are they always equivalent? always congruent? Make drawings to prove your answer.

*9. Can a right triangle be equivalent to an equilateral triangle? Use numbers to prove your answer.

*10. Can two squares be equivalent and yet not be congruent? Explain.

*11. Can a square be equivalent to a circle? Explain.

*12. Can a square be equivalent to a triangle? congruent to a triangle? Explain.



SYMMETRY, THE "MUSIC OF MATHEMATICS"

The picture shows the doorway of a New England house, built about 1800. If the vertical line between the two doors were extended to the roof of the porch, it would divide the doorway into two equal and congruent, but **opposite** parts. The dividing line is called the **axis of symmetry.** The doorway is said to be **symmetrical.**

The arrangement of two congruent figures, so that **one is opposite the other,** is found in plant and animal life, and is widely used in design.

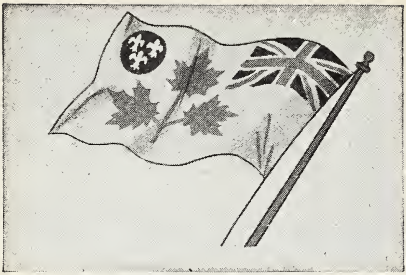
There are three kinds of symmetry: **point** symmetry, **line** symmetry, and **plane** symmetry.

POINT SYMMETRY

In point symmetry, the line of symmetry begins at a point. Such flowers as the black-eyed Susan and the daisy are illustrations of point symmetry. In point symmetry, each diameter is an axis of symmetry.

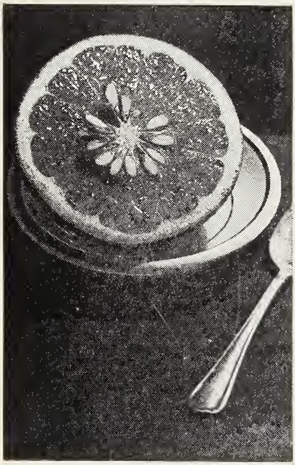
1. How many lines of symmetry may be drawn in a circle?

2. If a circle is divided into two parts by a line which does not pass through the centre, are the two parts symmetrical? Explain.



LINE AND PLANE SYMMETRY

Each maple leaf in Canada's Battle Flag represents **line symmetry.** The main rib divides the leaf into two congruent parts. This dividing line is the **axis of symmetry.** In an isosceles triangle the altitude is the axis of symmetry.



1. Draw an isosceles triangle and construct its axis of symmetry. (Bisect the vertex angle.)

2. If a triangle has all sides unequal, can an axis of symmetry be constructed for the triangle? Check your answer by attempting to construct the axis of symmetry.

Cut an orange in half and put a sheet of waxed paper between the halves. The halves on each side of this plane are the same, so the orange is symmetrical with respect to the plane. This is called **plane symmetry.**

3. Why is it possible to have more than one plane as an axis of symmetry for an orange or an apple?

4. For a plane to be an axis of symmetry of a sphere, must the plane pass through the centre of the sphere? Explain.

SOME APPLICATIONS OF SYMMETRY

1. When one looks in a mirror, does his image represent symmetry or congruence?

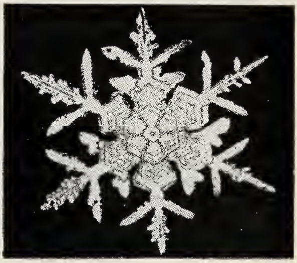
2. What type of symmetry is represented by the wings of the butterfly?

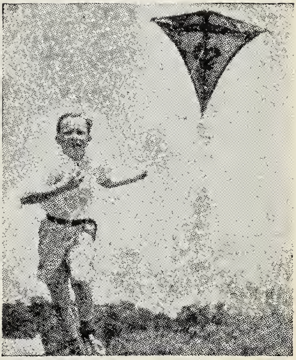
3. What is the axis of symmetry in the antelope head?

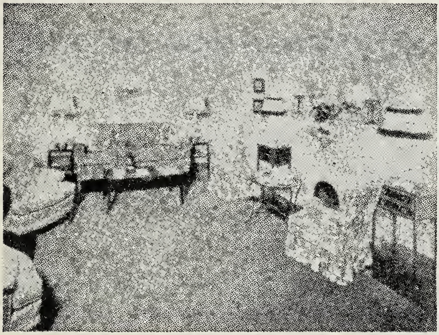
4. In the living room, tell which furnishings are arranged symmetrically; which are not.

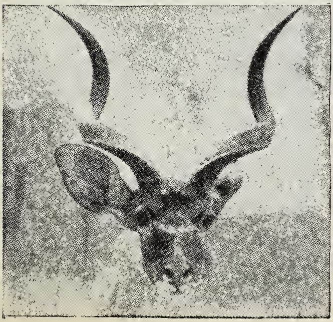
5. What is the line of symmetry in the kite?

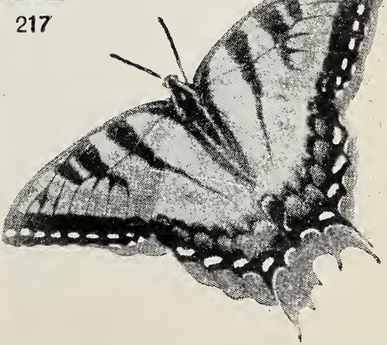
6. How many lines of symmetry can you find in the snowflake? the butterfly?











USING THE VOCABULARY OF ARITHMETIC

Define each term given below or use it correctly in a sentence. If you do not know the meaning of a term, turn to the key page in parentheses.

axis of symmetry	(215)	parallel lines	(206)
bisect	(205)	pentagon	(211)
coincide	(213)	perpendicular	(205)
congruent	(213)	plane symmetry	(216)
equivalent	(214)	point symmetry	(215)
inscribed polygon	(208)	regular polygon	(207)
line symmetry	(216)	segment of a line	(205)
octagon	(207)	symmetry	(215)

*TOPICS FOR SPECIAL REPORTS

1. What is Gothic architecture? What kind of symmetry is represented by the Gothic arch?

2. Place a drop of ink on a sheet of paper and fold the paper. The ink blot forms what kind of symmetry?

3. List 6 different shapes used for highway signs. What signal does each shape flash to the motorist?

4. Letter the 26 capitals of the alphabet. Which are symmetrical?

5. Name some geometric figures used in buildings, linoleum, or in embroidery. Construct four of these patterns.

6. Three famous problems in mathematics which have not, as yet, been solved are: (1) squaring the circle; (2) trisecting an angle; and (3) doubling a cube. Find what is meant by each of these problems.

7. Draw two triangles. Bisect, at right angles, the sides of the one triangle. Bisect the angles of the other triangle. If your construction is correct, the bisectors in each triangle will meet in a point.

HOW WELL DO YOU REMEMBER?

1. What is a regular polygon?

2. What is the difference between drawing an angle and constructing an angle?

3. Draw an angle of 70° and bisect it. Check your construction by measuring each angle formed.

4. At point C on line AB, erect a perpendicular. On the perpendicular, measure segment $CD = 2$ inches. At point D draw a line parallel to AB. What kind of angle will the parallel line make with line CD?

5. Construct an equilateral triangle.

6. If two triangles are congruent, do they have the same area? Why or why not?

7. If two triangles have the same area, must they be congruent? Why or why not?

8. If two triangles are congruent, are their perimeters equal? Why or why not?

9. If two figures are symmetrical, do they have the same area? Explain fully.

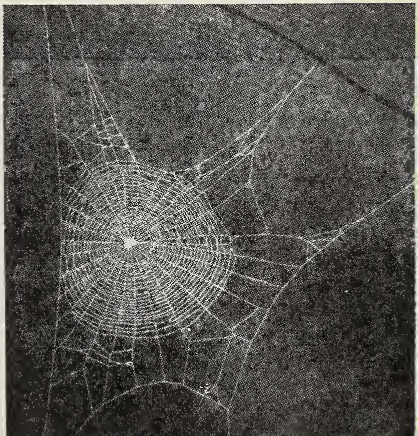
10. What is the difference between congruency and symmetry?

11. Name the three kinds of symmetry. Illustrate each.

12. What kind of symmetry is shown by the spider web?

13. Arrange two copies of this book so as to illustrate symmetry; to illustrate congruency.

14. How many degrees are at the centre of a regular inscribed pentagon? a regular inscribed hexagon? a regular inscribed octagon?



THINGS TO REMEMBER

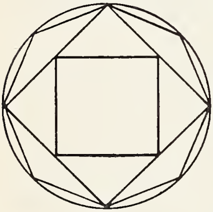
1. *How to bisect a line and an angle.*
2. *How to construct an angle equal to another angle.*
3. *How to construct a perpendicular from a point to a line.*
4. *How to construct a line parallel to a given line.*
5. *The meaning of congruence and symmetry.*

TEST ON CHAPTER X

1. Draw a line $3\frac{1}{2}$ inches long and bisect it. Check the accuracy of your construction by measuring the two segments.

2. Draw angles of 80° and 150° and then bisect them. With your protractor test the accuracy of your construction.

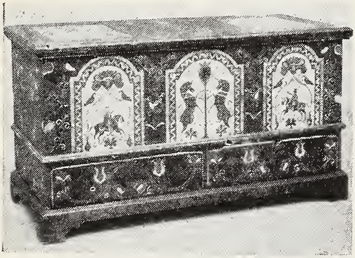
3. Draw a triangle and construct an altitude from any vertex.



4. Construct a regular hexagon with a side of 2 inches.

5. Two fields are equivalent in area but not congruent. Make a drawing to show how this is possible.

6. Construct the geometric design shown at the left.



7. What type of symmetry is represented by: *a*. sunflower; *b*. elm leaf; *c*. double doorway; *d*. an orange?

8. The picture represents an 18th century Pennsylvania Dutch chest. Name parts of the design of the chest which are symmetrical; congruent.

PROGRESS TEST

Work the test and have your paper scored. If you made errors, turn to the key pages in parentheses where the work is explained.

1. (8)

$$\begin{array}{r}368\\976\\409\\354\\765\\\hline\end{array}$$

2. (20)

$$\begin{array}{r}17.6\\9.3\\0.8\\3.5\\20.7\\\hline\end{array}$$

3. (8)

$$\begin{array}{r}40375\\-20398\\\hline\end{array}$$

4. (9)

$$\begin{array}{r}70304\\\times 508\\\hline\end{array}$$

5. (12)

$$46\overline{)30257}$$

6. (22)

$$2.7\overline{)18.657}$$

7. What fraction multiplied by $\frac{6}{7}$ is equal to $\frac{3}{4}$? (18)

8. Multiply $16\frac{3}{4}$ by $8\frac{2}{3}$. (16)

9. The sum of two numbers is 148. If one of the numbers is 56.7, what is the other number? (20)

10. Write as per cents: $\frac{2}{3}$, $\frac{5}{8}$, .7, 1.3, 4. (61)

11. 12 = ? % of 60 (66)

12. 60 = 15% of ? (74)

13. 175% of 450 = ? (65)

14. $\frac{1}{2}$% of 1500 = ? (72)

15. 9 = 30% of ? (74)

16. 350 = ? % of 150 (66)

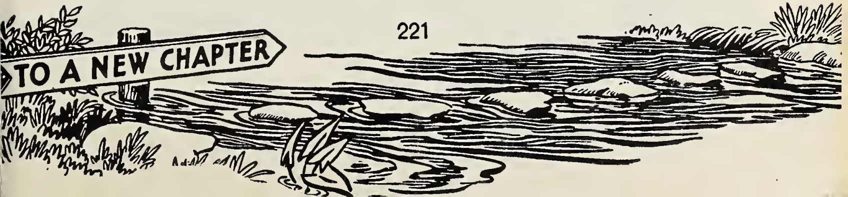
17. When the price of eggs increases from 25¢ to 35¢ a dozen, what is the per cent increase? (69)

18. When the price of wheat decreases from 90¢ to 75¢ a bushel, what is the per cent decrease? (69)

19. In the formula, $A = \frac{1}{2}bh$, find A when $b = 17$ and $h = 9$. (41)

20. In the formula $A = \frac{1}{2}bh$, find A when $b = 9\frac{3}{4}$ and $h = 15\frac{1}{2}$. (41)

21. Find the interest on a note for $450 at 6% for 45 days. (116)



CHAPTER XI

SOLIDS AND THEIR MEASURES

At Faraday School the boys in the upper grades have shop while the girls have cooking. Possibly you follow a like schedule in your school.

On parent-teachers' night each group exhibited samples (page 222) of its work.

1. Name objects made by the boys in the shop; by the girls in the school kitchen.

2. James showed his mother a book rack which he had made. He said: "Mother, this rack is 2 feet long, 26 inches deep, and 10 inches wide. The well for the books forms a right angle."

What other plane geometric figures do you recognize on the surfaces (**faces**) of the articles made by the pupils?

3. Think of any plane figure, such as the surface of this page.

a. How wide is it? *b.* How long?

c. How deep or thick?

d. Which question (*a*, *b*, or *c*) cannot be answered?

e. How many dimensions has a plane figure?

f. What are they?

4. *a.* How many dimensions has James' book rack?

b. What dimension does it have that the surface of this page, or any other plane figure, does not have?

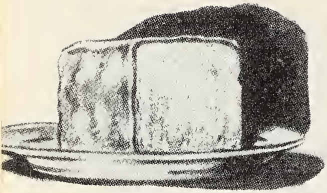
5. In arithmetic a **solid** is anything that has **length, width,** and **depth** or **thickness.**

a. Is an ice-cream cone a solid? Why or why not?

b. Is the ball of ice cream in the cone a solid? Why or why not?

c. May a solid be hollow? If so, name 5 such solids.

PRISMS



1. Mary's sponge cake, which she exhibited (page 222), is shown again in larger scale on this page.

a. Is this sponge cake a solid? Why or why not?

b. What is the shape of each surface (**face**) of the cake?

c. Is the bottom of the cake parallel to the top? Are the opposite sides parallel?

d. Why might this sponge cake be called a **rectangular solid**? In arithmetic we would call it a **rectangular prism,** because it is a **solid**, and its opposite sides are **rectangles** and are **parallel.**

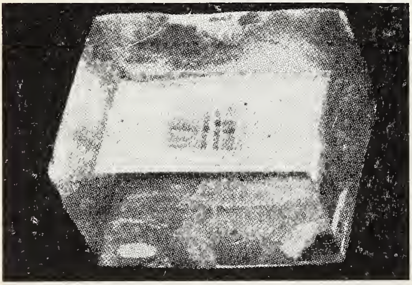
2. How many sides or faces does a rectangular prism have?

3. How many pairs of equal sides does a rectangular prism have?

4. A six-sided pencil, before it is sharpened, is what kind of prism?

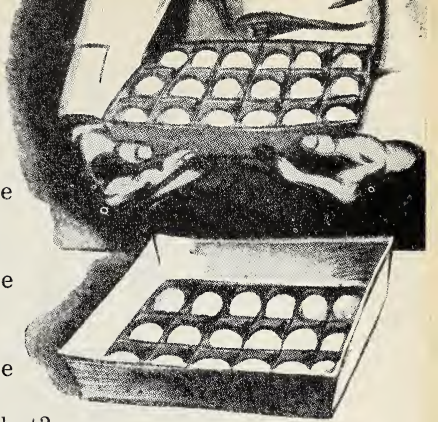
5. What kind of prism is this crystal of Iceland spar? (Iceland spar is one form of the mineral, calcite. Other forms are chalk and marble.)

6. "A bar of **Octagon** soap, please," ordered a customer. What kind of prism is a cake of this soap?



7. John noticed that his young brother's building blocks had 6 equal **square** faces or sides. What name is given to this form of rectangular prism (page 226)?

THE CAPACITY OF AN EGG CRATE



1. In the carton:

a. How many eggs have been placed in each row?

b. How many rows?

c. How many eggs in the top layer?

d. In the bottom layer?

e. How many eggs in the carton?

f. How many dozen is that?

2. *a*. An egg carton has 8 eggs to a row and 6 rows to a layer. How many eggs are there to each layer?

b. If the carton has 4 layers, how many eggs will it contain?

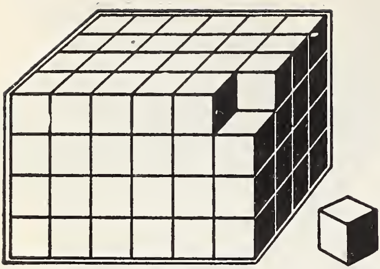
c. How many dozen is that?

The number of eggs which a carton will contain is its **capacity**; that is, **the number of units of measure it will hold.** The unit of measure of the carton above is one egg. The number of these units which the carton will hold is the product of the number of eggs in one layer and the number of layers.

*3. An egg carton has e eggs to a row and r rows. Write the formula for the number of eggs to a layer. Let N = the number.

*4. If there are L layers to the carton (problem 3), write the formula for the number of eggs the carton will contain. Let N = the number.

*5. Write the formula for the number of dozens the carton (problems 3, 4) will hold. Let D = the number of dozens.



VOLUME OF A RECTANGULAR PRISM

1. Here is a box of building blocks, one of which has dropped from the box. Each face of this block is one inch square. What kind of a rectangular prism is it?

2. *a*. If the cube is one inch on a side, how many **cubic inches** does it contain? (HINT: 1″ × 1″ × 1″ = ? cu. in.)

b. **Volume is the number of cubic units which a solid contains.** What is the volume of the building block?

3. How many cubes are in one layer of building blocks?

4. How many cubes are in the entire box?

5. How many cubic inches does the box contain?

There are 6 cu. in. in one row of the top layer.
There are 4 rows in the top layer.
Then there are 4 × 6 cu. in., or 24 cu. in., in one layer.
There are 4 layers.
Then there are 4 × 24 cu. in., or 96 cu. in., in the box.
96 = 4 × 6 × 4, the product of the three dimensions: length, width, height.

RULE: **The volume (number of cubic units) of a rectangular solid is equal to the product of the number of linear units in its length, width, and height.**

FORMULA:

$$V = lwh$$

6. *a.* What does each letter in the formula represent?

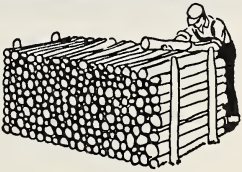
b. Tell what the formula means.

c. Assume that $l = 2$, $w = 3$, and $h = 4$, and prove that the value of V does not change if the formula is written $V = whl$, $V = hwl$, or $V = lhw$.

7. In a box there are 8 cubes in each row with 6 rows in a layer. How many cubes will the box hold if there are 4 layers?

8. Find the volume of the following rectangular prisms:

	a.	*b*	*c*	*d*	*e*	*f*	★*g*
l =	6 in.	8 ft.	12 in.	5 yd.	4.6 ft.	25 in.	30 cm.
w =	4 in.	6 ft.	12 in.	2 yd.	3.1 ft.	18 in.	16 cm.
h =	4 in.	4 ft.	12 in.	3 yd.	2 ft.	9 in.	15 cm.
V =	?	?	?	?	?	?	?



9. A cord of wood is a pile 8 feet long, 4 feet wide, and 4 feet high. How many cubic feet of wood are in a cord?

10. At 40¢ a cubic foot, find the cost of building a cement wall 8 inches thick, 4 feet high, and 150 feet long.

11. A cubic foot of ice weighs about $57\frac{1}{2}$ pounds. At 50¢ a 100 pounds, find the cost of a piece of ice 18 inches long, 12 inches wide, and 15 inches high.

★12. A quarter pound of butter is $4\frac{1}{2}$ inches long and $1\frac{1}{4}$ inches square. How many cubic inches are there to a pound of this butter?

★13. A cubic foot of a certain quality of granite weighs 175 pounds. Find the weight of a rectangular piece of this granite, 6 feet long, $2\frac{1}{2}$ feet wide, and 4 inches thick.

★14. Measure the inside dimensions of any rectangular box. How many cubic inches does your box contain?

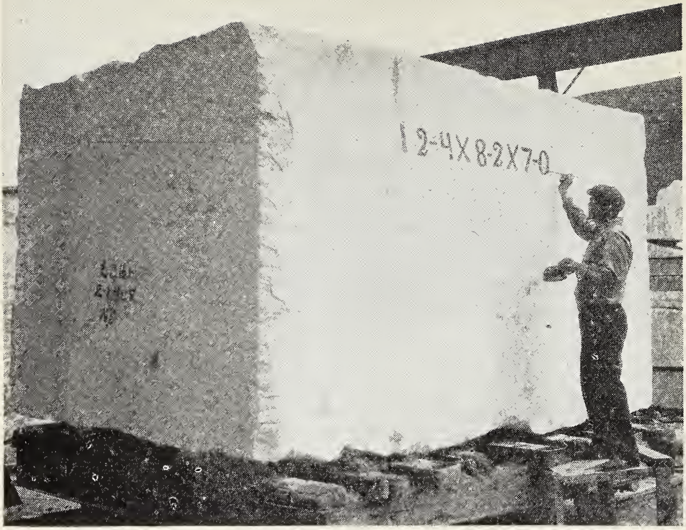


FIG A. This huge block of marble was quarried near Proctor, Vermont

A 64-TON BLOCK OF MARBLE

One of the largest blocks of marble ever quarried is shown in Figure A. This block is one of two such blocks required for supports at the main entrance of a large building.

1. What are the dimensions as painted on this block of marble (12–4 means 12 feet, 4 inches)?

2. What is its volume? (Assume that the block is a rectangular prism.)

***3.** The block, as you see it, weighed about 64 tons. How much did it weigh a cubic foot? Select from the following weights the one closest to the true weight

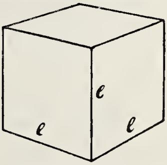
a. 150 lb.; *b*. 175 lb.; *c*. 180 lb.; *d*. 190 lb.; *e*. 200 lb.

THE VOLUME OF A CUBE

A cube, as you may recall, is a rectangular prism all sides of which are equal. Therefore, $l = w = h$. The formula for a rectangular prism, $V = lwh$, when used for a cube can be written, $V = l \times l \times l$; or $V = w \times w \times w$; or $V = h \times h \times h$.

In writing the formula for the volume of a cube, ***e*** is generally used for **edge.** The formula then becomes

$$V = e \times e \times e = e^3.$$



e^3 is read "e-cube." It means that e is used three times as a factor. If $e = 4$, then $e^3 = 4 \times 4 \times 4$, or 64.

1. Find the number of cubic inches in a cube, 12 inches on a side.

2. How many cubic feet of ice are in a cube, 2 feet on a side?

3. If a cubic foot of ice weighs $57\frac{1}{2}$ pounds, find the weight of a cubic block of ice, 2 feet on a side.

4. How many one-inch cubes are required to make a cube 2 inches on a side? 3 inches on a side? 4 inches on a side?

5. Write the cubes of all of the numbers from 1 to 12.

6. If you forget the number of cubic inches in a cubic foot, how can you compute the number?

7. Prove that there are 27 cubic feet in a cubic yard.

*8. Doubling the edge of a cube has what effect on its volume?

*9. Prove that the area of a cube is $6e^2$.

*10. Doubling the edge of a cube has what effect on its area?

FINDING THE VOLUME OF ANY PRISM

1. *a.* Mary is eating a serving of ice cream 4″ long, 1″ high, 2″ wide. After she has finished, what volume of ice cream will she have eaten?

b. What formula did you use to find this volume?

c. What was the area of the base of this brick of ice cream? (HINT: $l \times w$.)

d. Rewrite the formula (volume of a rectangular prism) and substitute B (base) for lw.

e. Find the volume of the brick of ice cream, using the formula $V = Bh$.

f. What does B represent in this formula?

RULE: **The volume of a prism is equal to the product of the number of square units in its base and the number of linear units in its height.**

FORMULA: $V = Bh$

2. Find the following:

	a	*b*	*c*	*d*	*e*
$B =$	18 sq. in.	27 sq. ft.	15.6 sq. ft.	56 sq. cm.	$12\frac{1}{4}$ sq. ft.
$h =$	5 in.	4 ft.	3.4 ft.	12 cm.	$2\frac{1}{2}$ ft.
$V =$	?	?	?	?	?

LET'S PRACTISE

	a	*b*	*c*
1.	$9\frac{1}{2} \times 37 = ?$	$16\frac{3}{8} - 11\frac{3}{4} = ?$	$370 \times 580 = ?$
2.	$165\overline{)72397}$	$4\frac{1}{2} \div 2\frac{3}{8} = ?$	$1.8 \times 6.55 = ?$
3.	$.25 \times .45 = ?$	$1.1\overline{)176}$	$16\overline{)9}$
4.	1.5% of 45 = ?	$\frac{1}{2}$% of 780 = ?	345% of 26 = ?
5.	15 = ? % of 120	300 = ? % of 120	30 = ? % of 36
6.	18 = 6% of ?	40 = 125% of ?	57 = 1% of ?
7.	102.5% of 150 = ?	60 = 120% of ?	800 = ? % of 300

RECTANGULAR SOLIDS

1. Jack is building a bin, 8 feet long and 5 feet wide, inside dimensions, to hold 160 bushels of wheat when level full. Allowing $1\frac{1}{4}$ cubic feet to a bushel, how high should he build the bin?

Since 1 bu. occupies $1\frac{1}{4}$ cu. ft. of space, 160 bu. will occupy $160 \times 1\frac{1}{4}$ cu. ft., or 200 cu. ft.

The area of the base is 40 sq. ft. $(8 \times 5 = 40)$

Then, $200 \div 40 = 5$, no. of ft. in height of the bin.

2. Allowing 42 cubic feet to a ton of soft coal, to what depth will 10 tons of coal fill a bin with a floor area of 70 square feet?

3. A triangular prism has a volume of 96 cubic feet. If the prism is 2 feet high, what is the area of its base?

4. A farmer has 440 bushels of wheat stored in a bin, 12 feet long and 5 feet wide. To what depth is the bin filled? ($1\frac{1}{4}$ cu. ft. = 1 bu.)

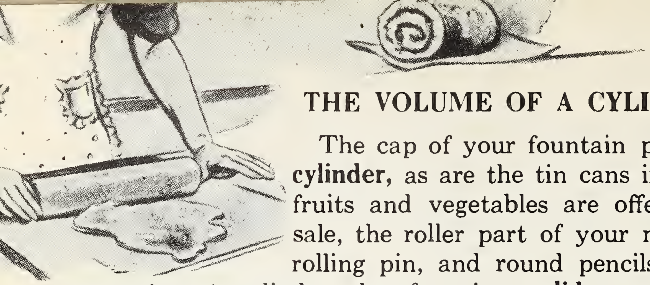
5. An aquarium, 24 inches long and 14 inches wide, contains 12 gallons of water. If a gallon contains 277.4 cubic inches, what is the depth of the water?

6. The bed of an autotruck is 9 feet long, 5 feet wide, and $1\frac{1}{2}$ feet high (inside dimensions). If a cubic yard contains 27 cubic feet, how many cubic yards of dirt will the truck hold when level full?

*7. If a cubic foot contains .8 of a bushel, to what depth will 240 bushels of grain fill a rectangular bin, 12 feet long and 5 feet wide?

*8. If the three dimensions of a rectangular prism are doubled, how has the volume been changed?

*9. If two dimensions of a rectangular prism are doubled, how has the volume been changed?



THE VOLUME OF A CYLINDER

The cap of your fountain pen is a **cylinder,** as are the tin cans in which fruits and vegetables are offered for sale, the roller part of your mother's rolling pin, and round pencils before sharpening. A cylinder, therefore, is a **solid—round, and with 2 circular ends (bases), equal and parallel.**

1. How long is the cap of your fountain pen or your circular pencil? What is the diameter of its base? Why may either object be called a **circular prism**?

2. The formula for the volume of a prism is $V = Bh$. The base of a cylinder is a circle. Therefore the formula for the volume of a cylinder is $V = \pi r^2 h$. Why?

3. Helen found that the diameter of the inside of a cylindrical can was 4 inches; its height, 5 inches. How many cubic inches did the can contain?

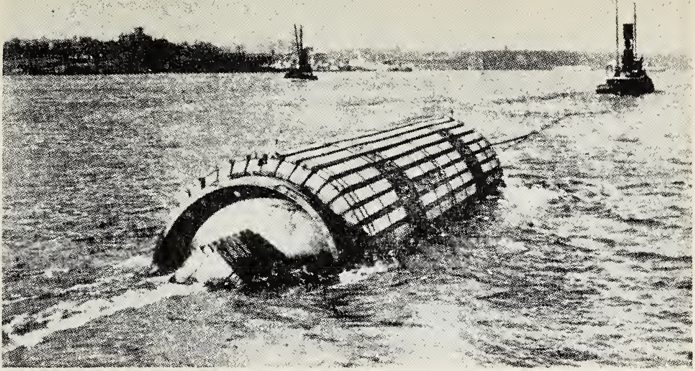
If $d = 4$, $r = 2$
$\pi = \frac{22}{7}$
$h = 5$
$V = ?$

$V = \pi r^2 h$, the formula
$V = \frac{22}{7} \times 2 \times 2 \times 5$
$V = 62\frac{6}{7}$
The volume is $62\frac{6}{7}$ cubic inches.

Find the volume of cylinders whose dimensions are: (Use $\pi = \frac{22}{7}$)

4. $r = 3$ in., $h = 7$ in.
5. $r = 4$ ft., $h = 6$ ft.
6. $r = 3\frac{1}{2}$ ft., $h = 6$ ft.
7. $r = 5$ ft., $h = 12$ ft.
8. $r = 1$ yd., $h = 4$ yd.
9. $r = 20$ cm., $h = 35$ cm.

*10. A hot-water tank is 18 inches in diameter and 42 inches high. How many gallons will it hold? 277.4 cu. in. = 1 gal.; 1 cu. ft. = $6\frac{1}{4}$ gal.)



FLOATING A CYLINDER

This cylindrical tank was towed from New York City up the Hudson River, through the Erie Canal, Lakes Erie, Huron, and Michigan to Whiting in northern Indiana, a distance of about 1370 miles.

1. The tank weighs about 460,000 pounds. How many tons is that?

2. It is 80 feet long and 15 feet in diameter, inside dimensions. What is its volume?

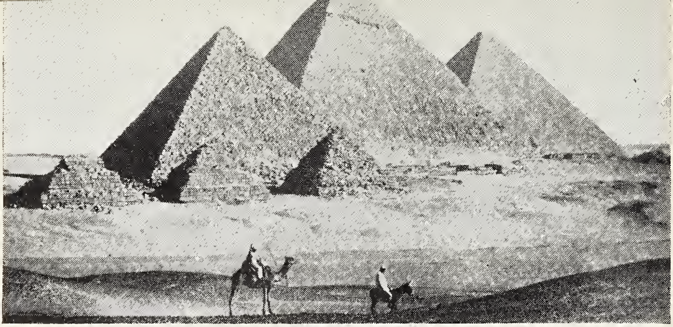
3. The tank is used for the storage of oil. Allowing $6\frac{1}{4}$ gallons to a cubic foot, find the number of gallons of oil which may be stored in this tank.

4. The tank is 25 feet longer than a standard flat freight car. What is the length of a standard freight car?

5. The time required to tow the tank was 16 days. What was the average distance moved each day?

*6. The **specific gravity** of an object is found by dividing its weight by the weight of a like volume of water. If a cubic foot of steel weighs 460 pounds and a cubic foot of water weighs 62.5 pounds, find the specific gravity of steel.

*7. Steel is much heavier than water. Why did this huge steel tank float, not sink?



PYRAMIDS AND CONES

FIG. A

In first place among "*The Seven Wonders of the World,*" as chosen by the peoples of ancient Greece, were the Pyramids of Egypt (Fig. A). These great tombs of the kings have given their name, **pyramid,** to all **solids having triangular sides which meet in a point at the top.**

1. What is the shape of each side (face) of the Pyramid of Cheops (Fig. A)? Its highest point is the **vertex** of the pyramid.

2. What is the shape of its base?

3. Cheops, as originally built, was 768 feet square. Why might it be called a square pyramid?

4. What would you call a pyramid having: *a.* a triangular base? *b.* a rectangular base? *c.* a hexagonal base? *d.* an octagonal base?

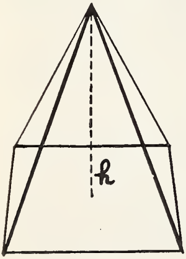


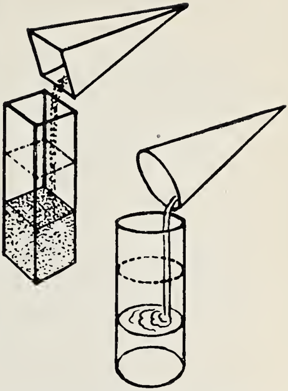
FIG. B

5. Cheops originally was 482 feet high. This altitude is the perpendicular distance between its base and vertex. (Fig. B.) How much higher or lower is this than the world's tallest building (1248 ft.)?

6. Sharpen a pencil in a pencil sharpener. The writing end of the pencil is now in the form of a **cone.** What is the chief difference between a pyramid and a cone?

Construct from cardboard or stiff paper a hollow prism and a hollow pyramid having the same height and base. Fill the pyramid with sand or water and pour it into the prism. When you have finished, the prism will be $\frac{1}{3}$ full.

In like manner, construct a cone having the same base and the same height as a cylindrical jar. Pour sand or water into the cone. Then empty it into the cylinder. When you have finished, the jar will be $\frac{1}{3}$ full.



7. The volume of a pyramid is what part of the volume of a prism of the same base and altitude?

8. Write the formula for the volume of a prism.

9. The formula for the volume of a pyramid must be

$$V = \frac{1}{3}Bh \text{ or } \frac{Bh}{3}$$

Why?

10. The volume of a cone is what part of the volume of a cylinder of the same base and height?

11. The formula for the volume of a cone must therefore be

$$V = \frac{1}{3}\,\pi r^2h \text{ or } \frac{\pi r^2h}{3}$$

Why?

VOLUMES OF PYRAMIDS AND CONES

1. Find the volume of a pyramid having a square base 6 inches on a side and an altitude of 8 inches.

Side of square base = 6
Area of base = 36
$h = 8$
$V = ?$

$V = \frac{Bh}{3}$, **the formula**
$V = \frac{1}{3} \times 36 \times 8$
$V = 96$

The volume of the pyramid is 96 cubic inches.

2. Find the volume of a cone which has an altitude of 6 inches and a base with a radius of $3\frac{1}{2}$ inches.

$r = 3\frac{1}{2}$ **or** $\frac{7}{2}$
$\pi = \frac{22}{7}$
$h = 6$
$V = ?$

$V = \frac{1}{3}\pi r^2 h$, **the formula**
$V = \frac{1}{3} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 6$

$$V = \frac{1 \times \overset{11}{\cancel{22}} \times 7 \times \overset{1}{\cancel{7}} \times \overset{\overset{1}{\cancel{3}}}{\cancel{6}}}{\underset{1}{\cancel{3}} \times \underset{1}{\cancel{7}} \times \underset{1}{\cancel{2}} \times \underset{1}{\cancel{2}} \times 1} = 77$$

The volume of the cone is 77 cubic inches.

Find the volumes of pyramids whose dimensions are:

	Area of Base	Height		Area of Base	Height
3.	36 sq. in.	8 in.	6.	15 sq. yd.	4 yd.
4.	24 sq. ft.	14 ft.	7.	54 sq. in.	7 in.
5.	42.6 sq. ft.	7.3 ft.	8.	20.6 sq. ft.	3.5 ft.

Find the volumes of cones whose dimensions are: (Use $\pi = 3.14$)

	Radius	Height		Radius	Height		Radius	Height
9.	3 ft.	7 ft.	11.	6 ft.	12 ft.	13.	8 in.	12.8 in.
10.	6 in.	9.5 in.	12.	10 in.	14.5 in.	14.	15 in.	36.5 in.

15. Find the volume of a pyramid, 15 feet high, which has a rectangular base, 8 feet long and 4 feet wide.

16. A granite monument in the shape of a pyramid is 10 feet high and has a square base 6 feet on a side. If a cubic foot of this granite weighs 180 pounds, find the weight of the monument.

17. Find the volume of a cone having a radius of 8 inches and a height of 14 inches. (Use $\pi = \frac{22}{7}$)

18. A conical pile of sand has a diameter of 14 feet and a height of $5\frac{1}{2}$ feet. About how many loads of $2\frac{1}{2}$ cubic yards each are in the pile? (Use $\pi = \frac{22}{7}$)

19. A conical pile of wheat has a diameter of 10 feet and a height of $3\frac{1}{2}$ feet. If a cubic foot contains .8 of a bushel, how many bushels are in the pile? (Use $\pi = \frac{22}{7}$)

★20. If the height of a pyramid or a cone is doubled, what effect does this have on the volume?

★21. If the area of the base of a pyramid or a cone is doubled, what effect does this have on the volume?

★MAGIC SQUARE

Here is shown a magic square with some of its cells vacant. Draw a square containing 36 cells and copy the numbers given. Then find the missing numbers.

?	$\frac{1}{12}$	$\frac{1}{2}$	$2\frac{1}{6}$	?	?
$\frac{1}{4}$	?	$\frac{7}{12}$	$1\frac{3}{4}$	?	$2\frac{1}{12}$
$2\frac{7}{12}$	$\frac{3}{4}$	?	$1\frac{5}{6}$	$2\frac{1}{4}$	$1\frac{2}{3}$
$\frac{2}{3}$	$2\frac{1}{3}$	?	$1\frac{5}{12}$	$\frac{5}{6}$	$1\frac{1}{4}$
$2\frac{1}{2}$	?	$2\frac{5}{6}$	1	$1\frac{1}{6}$	$1\frac{1}{3}$
$\frac{1}{3}$	3	$2\frac{5}{12}$	$1\frac{1}{12}$	$1\frac{1}{2}$	?

WHAT TIME IS IT?

Short, the dog shown before the microphone, barked. His voice was radioed around the world and back to the studio in $\frac{1}{8}$ of a second. Short mistook his bark for another's and kept up the conversation until cut off the air.

By radio, and in other ways, we have proved that our earth is almost a perfect **sphere**—curved like a ball so that all points on its surface are equally distant (or nearly so) from a point within called the **centre.**

1. What is the distance around the world at the equator?

2. If radio waves travel about 186,000 miles a second, prove that they can encircle the earth in about $\frac{1}{8}$ of a second.

3. If the earth is a sphere, how many degrees are there around it in any direction?

4. What do you call distances east or west around the earth, measured in degrees?

5. What lines are drawn on globes and maps to mark degrees of longitude?

6. The **prime** or **first meridian,** as you recall, passes through both poles of the earth and through Greenwich (London), England. What do you call distances in degrees east of the prime meridian? west of it?

7. Prove that the greatest longitude a place can have is 180° east or west.

8. *a*. How many hours does the earth require to make one complete turn or **rotation?**

b. Through how many degrees does it turn in one day?

c. Through how many degrees does it turn in one hour?

d. How long does the earth require to turn one degree in longitude? fifteen degrees?

9. What would be the difference in time of two places separated by 30° of longitude? 45°?

10. If London is on the 0° meridian and New York is near the 75° meridian, what is the difference in time between the two cities?

11. If the time is 12 noon in London, what is the standard time on the 180° meridian?

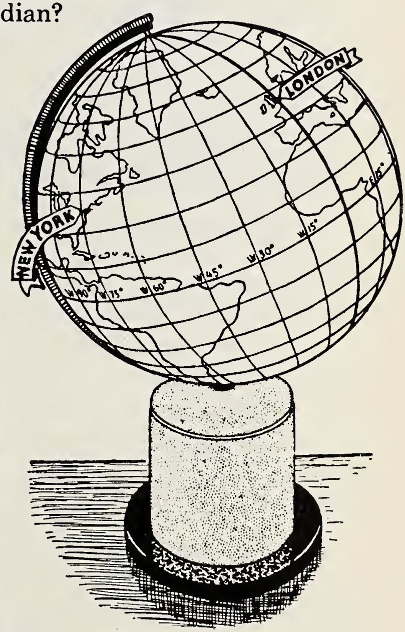
*12. On or near this meridian (180°) is the international date line where the date changes and the day is said to begin.

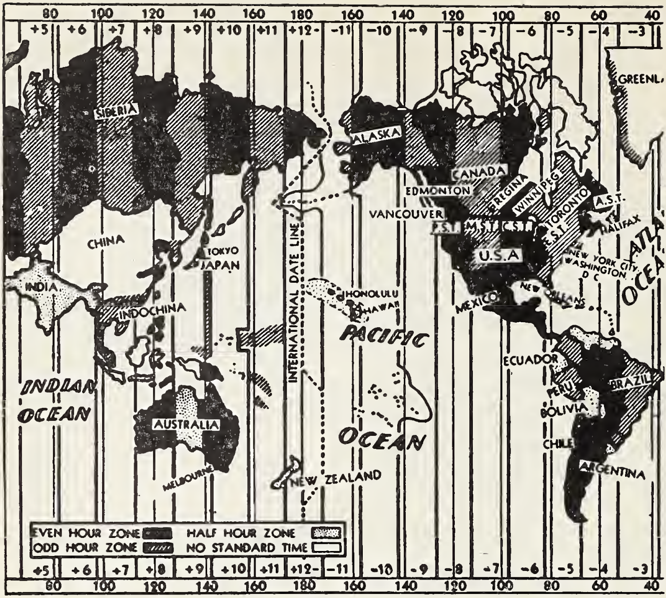
a. If the day is Saturday just east of this line, what day is it just west of the line?

b. If the day is Tuesday just west of the line, what day is it just east of the line?

c. If you crossed the international date line in a plane flying eastward, would you reset your watch? Explain.

*13. How many calendar days are there on the earth all the time?




80 100 120 140 160 180 160 140 120 100 80 60 40
+5 +6 +7 +8 +9 +10 +11 +12- -11 -10 -9 -8 -7 -6 -5 -4 -3
SIBERIA
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INTERNATIONAL DATE LINE
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EDMONTON
VANCOUVER
REGINA
WINNIPEG
TORONTO
A.S.T.
HALIFAX
P.S.T.
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E.S.T.
U.S.A.
NEW YORK CITY
WASHINGTON D C
NEW ORLEANS
MEXICO
HONOLULU
HAWAII
PACIFIC
OCEAN
INDIAN OCEAN
AUSTRALIA
MELBOURNE
NEW ZEALAND
ECUADOR
PERU
BOLIVIA
BRAZIL
CHILE
ARGENTINA
GREENL.
ATLA OCEA
EVEN HOUR ZONE
ODD HOUR ZONE
HALF HOUR ZONE
NO STANDARD TIME

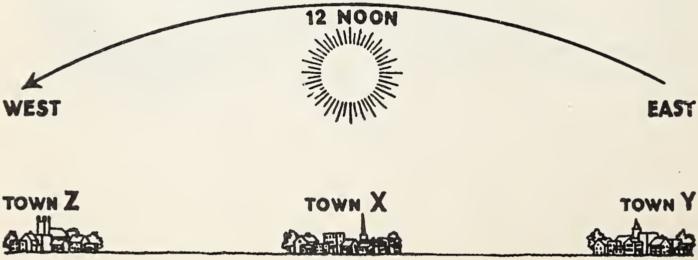
TIME DIFFERENCES BETWEEN PLACES

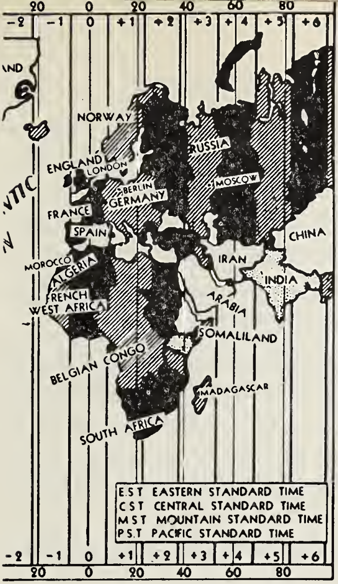
1. When the sun crosses the meridian of any place, the sun time of that place is **12 noon,** or **12M** (**meridian**).

a. Does the sun appear to move from east to west or from west to east?

b. What is meant by A.M.? P.M.?

c. When it is 12 noon (sun time) at town X, is it A.M. or P.M. (sun time) in town Y, one mile east? in town Z, one mile west?


12 NOON
WEST
EAST
TOWN Z
TOWN X
TOWN Y


20 0 20 40 60 80
-2 -1 0 +1 +2 +3 +4 +5 +6
NORWAY
RUSSIA
ENGLAND
LONDON
BERLIN
GERMANY
MOSCOW
FRANCE
SPAIN
CHINA
IRAN
INDIA
MOROCCO
ALGERIA
FRENCH WEST AFRICA
ARABIA
SOMALILAND
BELGIAN CONGO
MADAGASCAR
SOUTH AFRICA
E.S.T EASTERN STANDARD TIME
C.S.T CENTRAL STANDARD TIME
M.S.T MOUNTAIN STANDARD TIME
P.S.T PACIFIC STANDARD TIME
-2 -1 0 +1 +2 +3 +4 +5 +6
20 0 20 40 60 80

d. If all places on the earth followed sun time, what difficulties would occur? (HINT: Train and bus schedules, getting to work, shopping.)

2. Most of the nations of the world have agreed on a division of the surface of the earth into **time zones.**

a. Into how many time zones has the earth been divided?

b. About what is the width in degrees of each zone? (See top or bottom of the maps.)

3. Find the difference in time between any two adjacent zones. (All places within any one zone have the same time.)

4. In Canada the time zones are "Atlantic standard time," "Eastern standard time," "Central standard time," "Mountain standard time," and "Pacific standard time." In which zone do you live?

5. When it is 12 noon on the 75° meridian, what time is it all through the "Eastern" zone? "Central" zone? "Mountain" zone? "Pacific" zone? "Atlantic" zone?

6. When it is 12 noon on the 90° meridian, what time is it all through the "Central" zone? "Eastern" zone? "Pacific" zone? "Mountain" zone?

7. In what time zone is: *a.* Winnipeg? *b.* Halifax? *c.* Toronto? *d.* Regina? *e.* Edmonton? *f.* Vancouver?

TIME DIFFERENCES—Continued

8. Why are the boundaries of the time zones in Canada so irregular? (Hint: Suppose the 90° meridian ran down the main street of your community.)

9. When it is 4 P.M. on the Pacific coast of Canada, what time is it on the Atlantic coast of our country?

10. A difference of 1 hour of time between two places is equal to how many degrees of longitude?

11. When it is 9 A.M. Eastern standard time in Toronto, what is the standard time in Winnipeg? in Saskatoon? in Vancouver?

12. When it is 9 A.M. Pacific standard time in Victoria what is the standard time in Edmonton? in Fort William? in Montreal?

13. When it is noon in Halifax, what is the standard time in Brandon?

14. If you should travel from Halifax to Vancouver, how would you reset your watch to have standard time in Vancouver?

15. If you should travel from Victoria to Montreal, how would you reset your watch to have standard time in Montreal?

*16. State under what conditions in travelling you would set your watch ahead and how much; when you would set your watch back and how much.

*17. When it is 12 noon on Monday at Winnipeg, tell what time and day it is at

London, England
Berlin, Germany
Moscow, Russia
Tokyo, Japan
Melbourne, Australia
Honolulu, Hawaii.

⋆TOPICS FOR SPECIAL REPORTS

1. Make a formula for finding the area of the sides of a rectangular prism; the surface area of a cylinder.

2. What is meant by soilless gardening? How is a knowledge of cubical content necessary for the preparation of a soilless garden?

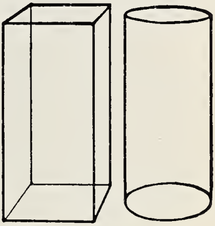
3. Name at least six illustrations in your home or community of each solid which you studied in this chapter.

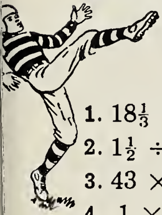
4. Make a table showing the formula for the area of every plane figure and the formula for the volume of every solid figure which you have studied in this book.

5. *a.* A **geographic mile** equals one minute of longitude at the equator. Find the circumference of the earth at the equator in geographic miles.

b. As a geographic mile equals about 1.152 statute miles, find the circumference of the earth in statute miles.

6. This prism has a square base equal to the diameter of the cylinder. The heights of the two objects are the same. Prove that the volume of the cylinder is .78 the volume of the prism.





LET'S PRACTISE

	a	*b*	*c*
1.	$18\frac{1}{3} - 11\frac{5}{6} = ?$	$9\frac{1}{4} \times 42 = ?$	$27 \div \frac{3}{4} = ?$
2.	$1\frac{1}{2} \div 4 = ?$	$3\frac{2}{3} \times 4\frac{1}{2} = ?$	$175\overline{)74460}$
3.	$43 \times 28.5 = ?$	$75 \div .8 = ?$	$.45 \times 3.8 = ?$
4.	$.1 \times .1 = ?$	6.5% of 140 = ?	38 = ? % of 19
5.	$\frac{1}{2}$% of 4800 = ?	15 = 3% of ?	101.5% of 12 = ?
6.	720 = 150% of ?	3 = ? % of 300	15% more than 20 $\doteq$?

HOW WELL DO YOU REMEMBER?

1. If a rectangular prism has all of its faces equal, what kind of a figure is it?

2. What is the formula for the volume of a rectangular prism? State the rule which the formula represents.

3. Find the volume of a rectangular prism whose dimensions are as follows: *a.* $l = 9$ in., $w = 5$ in., $h = 8$ in.; *b.* $l = 14$ ft., $w = 9\frac{1}{2}$ ft., $h = 5\frac{1}{2}$ ft.; *c.* $B = 56$ sq. ft., $h = 7$ ft.; *d.* $B = 78$ sq. in., $h = 9\frac{1}{4}$ in.

4. A cubic foot of water contains about $6\frac{1}{4}$ gallons. If a rectangular trough is 12 feet long, 1 foot wide, and 8 inches deep, how many gallons will it hold when full?

5. A bin, $12' \times 5' \times 8'$, is filled level with wheat. If a cubic foot of wheat contains .8 of a bushel, find the number of bushels in the bin.

6. A rectangular solid, 6 feet high, has a volume of 300 cubic feet. What is the area of its base?

7. A cylindrical tank for storage of fuel oil is 7 feet long and 3 feet in diameter. If a cubic foot of fuel oil contains $6\frac{1}{4}$ gallons, find the number of gallons the tank contains when filled. (Use $\pi = \frac{22}{7}$)

8. Using the formula $V = \frac{1}{3}Bh$, find V when $B = 36$ and $h = 8$.

9. Using the formula $V = \frac{1}{3}\pi r^2 h$, find V when $r = 3\frac{1}{2}$, $h = 6$. (Use $\pi = \frac{22}{7}$)

10. What is the difference in the time of two places if their difference in longitude is 60°? 75°? 105°?

11. Name the time zones in Canada and give the standard time in each zone when the time on the Atlantic seaboard is 1 P.M.

12. Are all rectangular prisms cubes? Are all cubes rectangular prisms? Explain.

THINGS TO REMEMBER

1. *What a solid is.*

2. *What the unit for measuring capacity is.*

3. *How to find the volume of prisms, cylinders, pyramids, and cones.*

4. *The meaning of a "time zone" and how it is determined.*

TEST ON CHAPTER XI

1. How many faces has a cube?

2. Find the volume of a cube having an edge of 6 inches.

3. A rectangular prism is 8′ × 6′ × 9′. What is its volume?

4. An aquarium, 21 inches long and 15 inches wide, is filled to a depth of 11 inches. If there are 277.4 cubic inches in a gallon, how many gallons of water does it contain?

5. A bin, 8 feet deep, has a square base, 6 feet on a side. Allowing .8 of a bushel to a cubic foot, how many bushels will it contain when full?

6. What is the difference between a pyramid and a cone?

7. A pyramid, 6 feet high, has a base 2 feet square Find its volume.

★8. When it is 5 P.M., Eastern standard time, in Toronto, what time is it in Regina, which follows Mountain standard time?

9. Is the altitude of the face of a triangular pyramid the same as the altitude of the pyramid? longer? shorter? Why?

10. Soft drinks were sold in a conical-shaped container for 6¢, or in a cylindrical-shaped container for 12¢. The bases and the heights of the containers were the same. Which container was the better buy?

PROGRESS TEST

Solve the problems and perform the indicated operations. If you made errors, turn to the key pages in parentheses where the work is explained.

1. $9\frac{1}{8} + 3\frac{1}{4} + 12\frac{1}{6}$ (14)
2. $4\frac{7}{8} \times 6\frac{1}{4} \times 1\frac{1}{2}$ (16)
3. $72.9 \div .27$ (22)
4. $50.4 - 37.8$ (20)
5. 125% of 475 (65)
6. 84 = ? % of 25 (66)
7. 18 = 6% of ? (74)
8. 409×6008 (9)
9. $27\frac{3}{4} \div 6\frac{1}{2}$ (18)
10. $.056 \times 134.5$ (21)
11. $.936 + .058 + .109$ (20)
12. $\frac{1}{2}$% of 760 (72)
13. 36 = ? % of 96 (66)
14. 210 = 70% of ? (74)

15. Round off to the nearest hundredth: *a.* .725; *b.* .495; *c.* .4495; *d.* .005; *e.* .995. (27)

16. It is estimated that there are 40,000 golfers in this country, 16% of whom are women. How many women golfers are in this country? (65)

17. The yearly interest from a loan of $550 is $16.50. What is the rate of interest? (108)

18. There are how many days from September 15 to December 1? (119)

19. Name three different kinds of life insurance policies. What is meant by each kind? (160)

20. Find the interest on $450 at 4% for 36 days. (107)

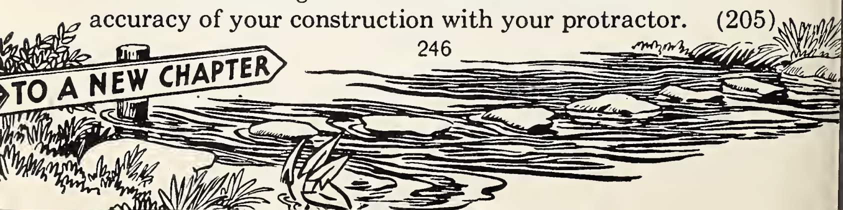
21. Find the cost of storing 4750 bushels of wheat from Oct. 4 to Dec. 15. (199)

22. What is meant by liability insurance? (170)

23. A tax rate of 28.6 mills on $1 is the same as how much on $100? on $1000? (187)

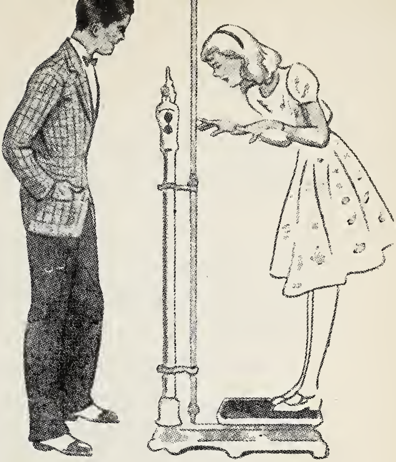
24. Construct a regular hexagon having a side of 3 inches. (209)

25. Draw an angle of 48° and bisect it. Check the accuracy of your construction with your protractor. (205)



CHAPTER XII

INDIRECT MEASUREMENT AND SQUARE ROOT



Elsie: "Bill, I weigh 84 pounds."

Bill: "I weigh more than you; I weigh 96 pounds."

1. How much more does Bill weigh than Elsie?

You have compared their weights by **subtraction.** You might have compared Elsie's weight with Bill's weight by **division**, thus: 84 ÷ 96, or $\frac{84}{96}$, or $\frac{7}{8}$. Hence, Elsie weighs seven eighths as much as Bill.

Or, you might have compared Bill's weight with Elsie's by division, thus: 96 ÷ 84, or $\frac{8}{7}$, or $1\frac{1}{7}$. Hence, Bill weighs $1\frac{1}{7}$ times as much as Elsie.

When two numbers are compared by division, the quotient, as you recall, is their **ratio.**

2. What is the ratio of \$2 to \$8?

$\$2 \div \$8 = \frac{2}{8} = \frac{1}{4}$ The ratio of \$2 to \$8 is the same as the ratio of 1 to 4.

3. What is the ratio of \$8 to \$2?

$\$8 \div \$2 = \frac{8}{2} = \frac{4}{1}$ The ratio of \$8 to \$2 is the same as the ratio of 4 to 1.

4. *a.* What is the ratio of 2 yards to 6 yards? *b.* of 6 yards to 2 yards? *c.* of 60 inches to 66 inches? *d.* of 66 inches to 60 inches? *e.* of 21 years to 24 years?

WRITING RATIOS

A ratio may be written in three different ways; for example, the ratio of 1 pound to 4 pounds may be written:

a. $1 \div 4$ *b*. $\frac{1}{4}$ *c*. $1 : 4$

The third ratio is read, "1 to 4." Sometimes the other two are read in the same way. The colon (:) is often used to express ratio.

1. What is the ratio of 5 years to 15 years?

2. What is the ratio of $18 to $36? of $36 to $18?

3. Mary has a box 12 inches long, 8 inches wide, and 2 inches high. *a*. What is the ratio of the width to the height? *b*. of the length to the height? *c*. of the length to the width? (The ratio of the length to the width is $12 : 8$ or $\frac{3}{2}$. The result may be left in the fraction form, $\frac{3}{2}$.)

4. Ethel is 12 years of age and her mother is 36 years of age. *a*. What is the ratio of Ethel's age to the age of her mother? *b*. of her mother's age to Ethel's age?

5. Old potatoes are selling at 20¢ a peck and new potatoes at 50¢ a peck. *a*. What is the ratio of the price of old potatoes to the price of new potatoes? *b*. of the price of new potatoes to the price of old potatoes?

6. For every 2 boys in a certain school, there are 3 girls. *a*. What is the ratio of the number of boys to the number of girls? *b*. of the number of girls to the number of boys?

7. There were 500 students and 400 adults at a football game. *a*. What was the ratio of the number of students to the number of adults? *b*. of the number of adults to the number of students?

8. Write the ratio of $3 \div 4$ in two other forms.

EXPRESSING RATIOS

1. What is the ratio of 4 inches to 2 feet?

2 ft. = 24 in.
4 in. ÷ 24 in. = $\frac{1}{6}$, the ratio.
Two quantities must be expressed in the same unit before the ratio between them can be found.

Find the ratios between the following:

2. 2 ft. and 2 yd.
3. 3 qt. and 2 gal.
4. 5 pk. and 3 bu.
5. 6 oz. and 2 lb.
6. 5 pt. and 1 qt.
7. 12¢ and $1
8. 10 da. and 1 wk.
9. 20 rd. and 1 mi.
10. 8 hr. and 2 da.

*11. 15 centimetres and 1 metre

*12. 2 metres and 30 centimetres

*13. 60 sq. rd. and 1 acre

14. The ratio of the circumference of a circle to the diameter is π. What is the ratio of the circumference to the radius?

15. *a.* What is the ratio of the perimeter of a square to a side? *b.* of a side to the perimeter?

16. *a.* What is the ratio of the perimeter of an equilateral triangle to a side? *b.* of a side to the perimeter?

17. *a.* What is the ratio of the perimeter of a regular hexagon to a side? *b.* of a side to the perimeter?

18. *a.* What is the ratio of the perimeter of a regular pentagon to a side? *b.* of a side to the perimeter?

*19. *a.* What is the ratio of the diameter of a circle to the circumference? *b.* of the radius to the circumference?

*20. What is the ratio of the area of a 2-inch square to the area of a 4-inch square?

*21. What is the ratio of the volume of a 4-inch cube to the volume of a 2-inch cube?

APPLICATIONS OF RATIO

1. John can ride 7 miles on his bicycle in the same length of time that he can walk 2 miles. How far could he walk in the time it would take him to ride 14 miles?

The ratio of the distance he can walk to the distance he can ride is $\frac{2}{7}$.

Then, $\frac{2}{7} \times 14 = 4$, number of miles he could walk in the time it takes him to ride 14 miles.

2. How far could John ride (problem 1) in the time it takes him to walk 3 miles?

3. Sally can read 40 pages of a book while Ruth is reading 30 pages. At that ratio, how many pages can Ruth read while Sally is reading 120 pages?

4. A baseball team won 6 of its first 11 games. At that ratio, how many games would the team win during a season of 154 games?

5. The radii of two circles are in the ratio of 2 to 3. If the circumference of the first circle is 30 inches, what is the circumference of the second circle?

6. If 3 stamped envelopes cost 14¢, what will be the cost of 18 stamped envelopes at the same rate?

7. When oranges sell at 6 for 35¢, how many can be bought for $1.05?

8. If two grapefruit cost 15¢, what will be the cost of 10 grapefruit?

9. When 3 bars of soap can be bought for 20¢, how many can be bought for $1 at the same rate?

10. Mrs. Sawyer paid 45¢ for ice cream to serve 6 people. At that rate how much would it cost to serve ice cream to 24 people?

DICTIONARY SCALE DRAWINGS

1. Martha saw in her dictionary a drawing of a mountain goat. Beneath it was printed $\frac{1}{36}$. On the same page there was a picture of a mouse with $\frac{1}{4}$ printed close to the animal's body. What did these fractions represent?

2. In the drawing of the mountain goat, the ratio of the size of the drawing to the size of the animal was $\frac{1}{36}$. That is, the average-sized goat is about 36 times the size of the picture in Martha's dictionary. If the drawing is $1\frac{1}{4}$ inches long, what is the length of an average-sized goat?

3. The fraction, $\frac{1}{70}$, was printed beneath the picture of a mule. What does the fraction represent?

4. The dictionary also showed a picture of rock crystal. Below the picture was printed × 100 to indicate the ratio of its size to the size of the crystal. If the picture of the crystal is 0.5 of an inch in diameter, what is the diameter of the crystal?

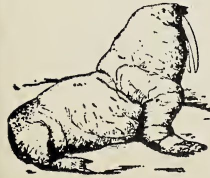
5. With the picture of a caterpillar is printed the ratio $\times 2\frac{1}{2}$. What does this ratio represent?

6. If a picture is full size, what is the ratio of its size to the size of the object?

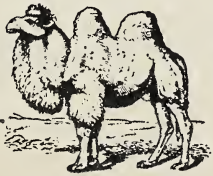
7. State what the following represent when used with pictures: $\frac{7}{12}$; $\times 2$; $\frac{1}{50}$; 1; $\times 500$.

*8. Find a dictionary drawing which gives the ratio of size to the size of the object. Tell what the ratio means.

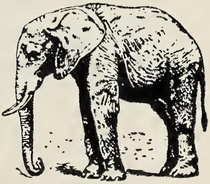
*9. Here are dictionary drawings of several animals. About how tall is each animal in real life?


Walrus

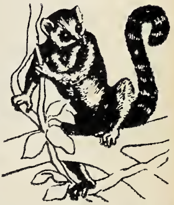
$\frac{1}{80}$


Bactrian Camel

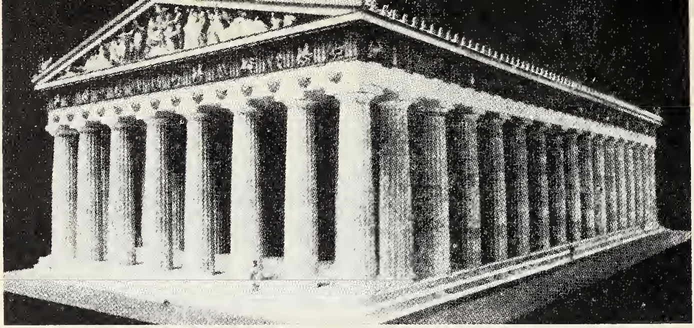
$\frac{1}{80}$


African Elephant

$\frac{1}{125}$


Ring-tailed Lemur

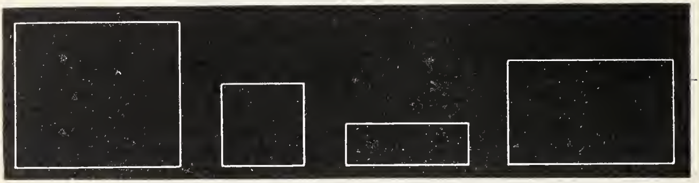
$\frac{1}{15}$



The Parthenon as the ancient Greeks saw it.

THE DIVINE PROPORTION

1. Which rectangle is most pleasing to you? Tell why.



Many, *many* years ago, the Greeks tried to find a ratio between width and length most pleasing to the eye. They decided on $\frac{5}{8}$. This relationship, called the **divine proportion,** they used in the building of temples (such as the Parthenon), the making of vases, and in other art work.

2. What is the length of a flag, 10 feet wide, if width and length are in divine proportion?

3. A room is 24 feet long. What should be its width if it is to meet the Greek ideal of divine proportion?

4. Measure a pane in the window of your schoolroom. How nearly does it conform to divine proportion?

*5. Which of two rectangular rugs more nearly approaches divine proportion: one that measures 9′ × 12′, or one that is 11′ × 16′?

APPLICATIONS OF RATIO—CONTINUED

1. In making solder, a manufacturer uses 2 pounds of tin to 3 pounds of lead. How many pounds of each metal would be used in making 25 pounds of this solder?

In every 5 pounds of the mixture, there are 2 pounds of tin and 3 pounds of lead.

The tin represents $\frac{2}{5}$ of the mixture; the lead $\frac{3}{5}$.

$\frac{2}{5} \times 25 = 10$; $\frac{3}{5} \times 25 = 15$

The mixture contains 10 pounds of tin and 15 pounds of lead.

2. In the Fairview School the ratio of boys to girls is as 3 to 4. If the total enrolment is 560, how many boys and how many girls are enrolled?

3. A recipe for making jam calls for 3 pounds of sugar to 4 pounds of berries. How much of each is needed to make 30 pounds of jam?

4. In a town election for mayor, the ratio of the votes for the two candidates was as 3 : 2. If there were 2635 votes cast, how many votes did each candidate receive?

5. A board, 14 feet long, is to be cut into two pieces having the ratio of 3 : 4. What will be the two lengths?

6. The sides of a triangle are in the ratio of 1 : 2 : 2. If the perimeter of the triangle is 25 inches, find the length of each side. (HINT: Find the sum of the ratios. The smallest side will be $\frac{1}{5}$ of the perimeter.)

7. When the ratio between any two sides of a triangle is 1, what kind of a triangle is it?

8. The angles of a triangle are in the ratio 3 : 2 : 4. Find the number of degrees in each angle. (HINT: 180° in the three angles.)

⋆PROPORTION

The ratio of 1 foot to 2 feet is $\frac{1}{2}$; the ratio of 4 feet to 8 feet is $\frac{4}{8}$ or $\frac{1}{2}$. Then the ratio of 1 : 2 is the same as the ratio of 4 : 8.

Two ratios which are equal to each other form a **proportion.**

A proportion may be written: $\frac{1}{2} = \frac{4}{8}$, or 1 : 2 = 4 : 8, or 1 : 2 :: 4 : 8. No matter what the form, the proportion means that the ratio of 1 to 2 is the same as the ratio of 4 to 8. For brevity this is usually read, "1 is to 2 as 4 is to 8."

Suppose a proportion were incomplete, as $\frac{2}{3} = \frac{?}{6}$. How would the missing number be found?

Change $\frac{2}{3}$ to sixths. $\frac{2}{3} \times \frac{2}{2} = \frac{4}{6}$

(a) Why does $\frac{2}{3} = \frac{4}{6}$?

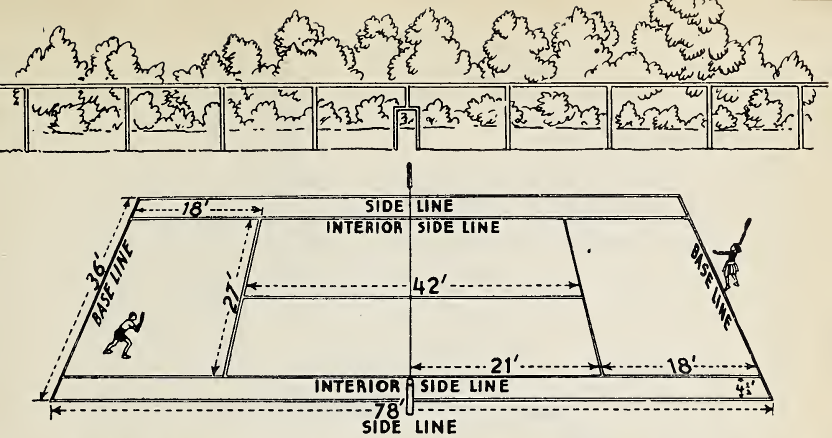
(b) What was the missing number in the proportion?

Find the missing number in each of the following proportions:

1. $\frac{2}{3} = \frac{?}{9}$
2. $\frac{3}{4} = \frac{?}{8}$
3. $\frac{5}{6} = \frac{10}{?}$
4. $\frac{7}{8} = \frac{21}{?}$
5. $\frac{2}{9} = \frac{?}{18}$
6. $\frac{?}{12} = \frac{10}{24}$
7. $\frac{5}{6} = \frac{25}{?}$
8. $\frac{5}{6} = \frac{?}{36}$
9. $\frac{15}{16} = \frac{?}{64}$
10. $\frac{7}{9} = \frac{42}{?}$
11. $\frac{?}{8} = \frac{15}{24}$
12. $\frac{9}{?} = \frac{27}{48}$

In the proportion $\frac{2}{3} = \frac{4}{6}$, the product of 2 and 6 equals the product of 3 and 4. These two products may be found by cross multiplication $\frac{2}{3} \times \frac{4}{6}$. Hence, 2 × 6 = 3 × 4.

13. Use the missing numbers (examples **1–12**), and prove that the two products in each example are equal.



HOW TO LAY OUT A TENNIS COURT TO SCALE

Before a house, an airplane, or any other building or machine is constructed, plans or blueprints of it must be drawn. All parts on the plan are in exact ratio, but smaller in size than the corresponding parts of the object. That is, they are **drawn to scale.**

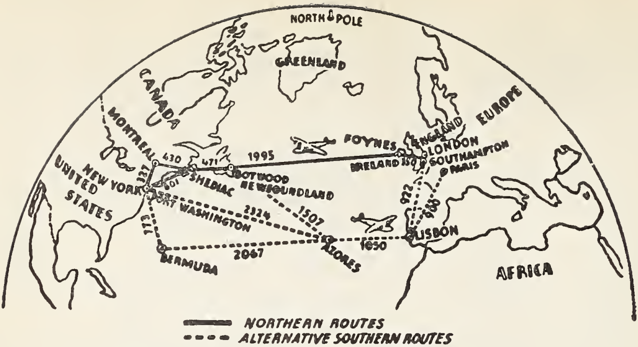
The above diagram shows the official size of a "singles" and a "doubles" tennis court. The part of the court between the two "base lines" and the two "interior side lines" is the playing surface for "singles." The "base lines" and the "side lines" mark the surface for "doubles."

1. Draw to scale, 1″ = 8′, a tennis court for both "singles" and "doubles."

2. On your diagram, what is the distance between the base lines? between the side lines?

3. A tennis court is enclosed by a fence 20 feet back of each base line and 8 feet from each side line. Draw to scale, 1″ = 16′, the plot enclosing the court, and a "singles"–"doubles" court.

4. What is the area enclosed by the plot (problem 3)?


NORTH POLE
GREENLAND
CANADA
EUROPE
MONTREAL
UNITED STATES
NEW YORK
430
471
1995
FOYNES
ENGLAND
LONDON
SOUTHAMPTON
PARIS
IRELAND
150
327
601
SHEDIAC
BOTWOOD
NEWFOUNDLAND
PORT WASHINGTON
2324
1507
922
LISBON
773
2067
1050
BERMUDA
AZORES
AFRICA
NORTHERN ROUTES
ALTERNATIVE SOUTHERN ROUTES

AIRWAYS TO EUROPE

Some air routes flown between New York and London are shown on the map. The distances are drawn to scale.

1. *a.* What is the airline distance from New York to the Azores? *b.* from the Azores to Lisbon? *c.* from Lisbon to Southampton? *d.* from New York to Southampton by the Azores-Lisbon route?

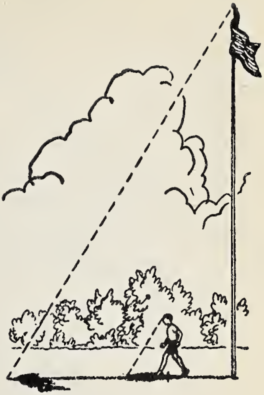
2. What is the distance from New York to Southampton by way of Newfoundland?

3. The distance from Newfoundland to the Azores is about 1500 miles. Measure the distance on the map and determine to what scale the map is drawn.

4. Measure the distance on the map between Bermuda and the Azores and check the scale determined in problem 3. How closely did your two answers (problems 3–4) agree?

*5. *a.* Measure the airline distance between the Azores and Southampton. *b.* How many miles is this, according to scale (problem 3)? *c.* How many miles can be saved by direct flight, Azores to Southampton, instead of by way of Lisbon?

MEASURING BY USE OF SHADOWS



If you dropped a weighted line from your bedroom window, you could find the distance from sill to ground quite easily by **direct measurement.** If you were asked to find the height of a tree, however, by direct measurement, the job would be much more difficult and somewhat risky.

A safer way to find the height of a tall object is by **indirect measurement.**

1. If a man, 6 feet tall, casts a shadow 8 feet long, what is the height of a flagpole which, at the same time, casts a shadow 40 feet long?

$\frac{6}{8} = \frac{3}{4}$, ratio of height of man to his shadow.
$\frac{3}{4} \times 40 = 30$ feet, the height of the pole.

2. A tree casts a shadow 54 feet long. If, at the same time, a pole, 9 feet high, casts a shadow 6 feet in length, what is the height of the tree?

3. A boy, 5 feet tall, casts a shadow 8 feet long. How high is a nearby building which, at the same time, casts a shadow 476 feet long?

4. If a man, 6 feet tall, casts a shadow 5 feet long, when standing near the Canadian Bank of Commerce Building in Toronto, what would be the length, at the same time, of the shadow cast by this tallest building in the British Empire (height 426 ft.)?

5. A stake, $6\frac{1}{2}$ feet high, casts a shadow 8 feet long. At the same time, a church spire casts a shadow 175 feet long. What is the height of the spire?

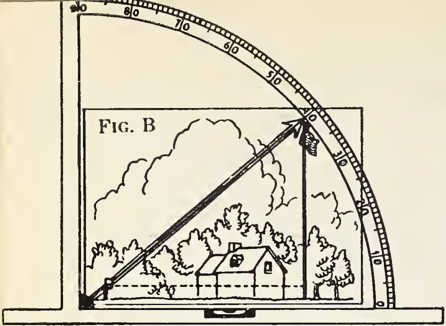


FIG. A

MEASURING BY USE OF SCALE DRAWINGS

The height and certain other dimensions of objects can also be measured fairly accurately by the use of a **quadrant** (Fig. A).

1. A quadrant forms what fractional part of a circle?
2. The pointer moves through how many degrees?
3. The pointer measures an angle of how many degrees?

Suppose your job is to measure the height of a flagpole.

a. Step off, or measure, any distance from the pole, let us say 100 feet. *b.* Hold the base of your quadrant parallel with the ground or pavement. *c.* Sight along the pointer to the top of the pole. *d.* Note the number of degrees in the **angle of elevation** (Fig. B). This angle happens to be 40°, but it might be up to 90°, depending on the height of the object and the distance of the observer from the object. *e.* Lay off, on ruled paper, a horizontal distance of 100 feet, using any convenient scale, as 1″ = 30′ (Fig. C). *f.* Let *A* be the point of observation, *B* the foot of the pole, and *C* the top of the pole. At *A*, construct an angle of 40°. *g.* Extend the side *AC* until it cuts the line *BC*. The point, *C*, represents the height of the pole above *B*. *h.* Assume that the observer stands $5\frac{1}{2}$ feet to the level of his eye. Give the height of the flagpole in feet.

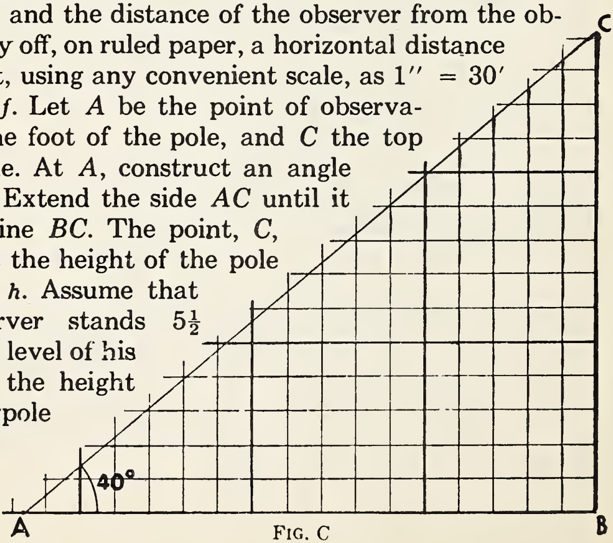


FIG. C

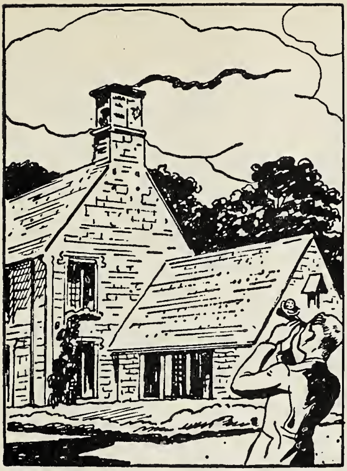


FIG. A

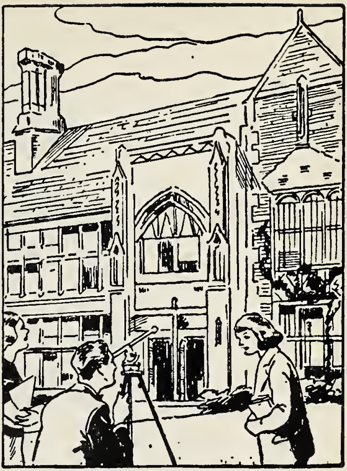


FIG. B

*THE CLINOMETER AND TRANSIT

The angle of elevation from any given point to **the top** of an object may also be measured with a **clinometer, one** form of which is shown in Figure A.

1. The angle of elevation of the top of a building, 75 feet from its base, was found by clinometer to be 30°. What was the height of the building? (Use a scale drawing.)

2. The angle of elevation of the top of a monument, 66 feet from its base, is 45°. Find the height of the monument by scale drawing. Are the height and the horizontal distance the same or different?

3. Some students (Fig. B) are measuring the angle of elevation of the top of their school building with a **transit.** This angle is 54° at 60 feet from the base of the building. By scale drawing, find the height of the building. (Add 5 feet for the height of the transit.)

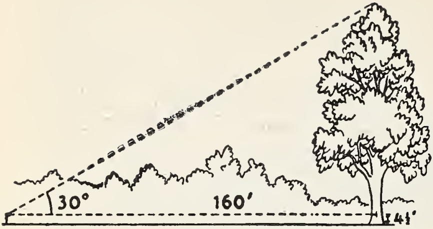


FIG. A

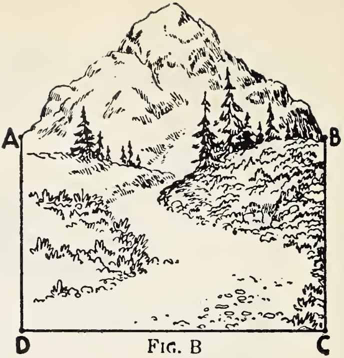


FIG. B

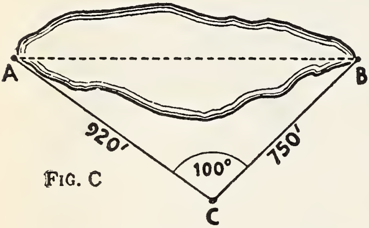


FIG. C

*APPLICATIONS OF INDIRECT MEASUREMENTS

Solve each of the following problems either by ratio or by scale drawing.

1. When the shadow of a man, 5 feet 10 inches tall, measured 7½ feet, the length of the shadow of a tower was 81 feet. What was the height of the tower?

2. George found the angle of elevation of the top of a tree, at a distance of 160 feet, to be 30°. If his horizontal line of vision was 4½ feet from the ground, what was the height of the tree (Fig. A)?

3. Find the height of a tree when the angle of elevation of the top is 20° at a distance of 180 feet.

4. A surveyor had to find the horizontal distance between points *A* and *B*, situated on opposite sides of a hill. He sighted *AD* and *BC* as shown (Fig. B), and then measured the line *CD*. Why are *CD* and *AB* the same length?

5. John saw a pond (Fig. C) at the foot of the meadow. He was 920 ft. from one end of the pond (*A*), and 750 ft. from the other end (*B*). How wide is the pond, if the angle between *A* and *B* and John's station is 100°?

THE SIDES OF A RIGHT TRIANGLE

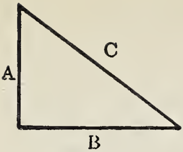


FIG. A

1. What kind of triangle is Figure A?

2. Which side of the triangle is opposite the right angle? This side is called the **hypotenuse.**

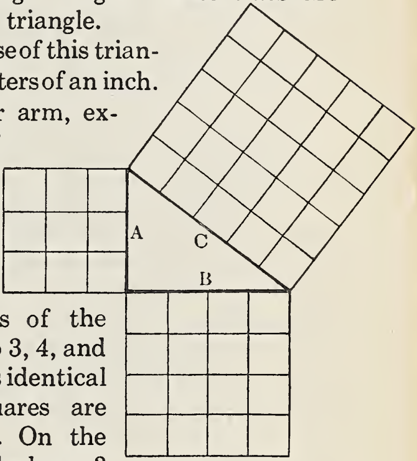
3. Which sides form the right angle? These sides are called the **arms** or **legs** of the triangle.

4. How long is the hypotenuse of this triangle? Express the length in quarters of an inch.

5. How long is each leg or arm, expressed in quarters of an inch?

6. Why is a right triangle of this size called "3–4–5 triangle"?

7. In this right triangle each side has been converted into a square and the sides of the squares have been broken into 3, 4, and 5 parts to form smaller squares identical in size. *a.* How many squares are built on the hypotenuse? *b.* On the smaller of the two legs? *c.* On the larger?



8. How does the number of squares on the hypotenuse compare with the sum of the squares on the other two sides?

PYTHAGORAS

You have discovered for yourself one of the most famous rules in mathematics—the **hypotenuse rule** or the **rule of Pythagoras.**

About 2500 years ago a Greek mathematician, Pythagoras, proved that **the square erected on the hypotenuse of a right triangle equals the sum of the squares of the other two sides,** that is, $H^2 (C^2) = B^2 + A^2$.

TEST FOR A RIGHT TRIANGLE

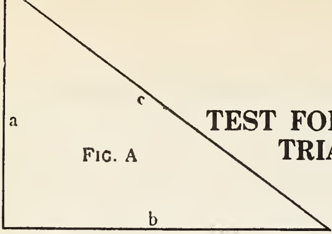


FIG. A

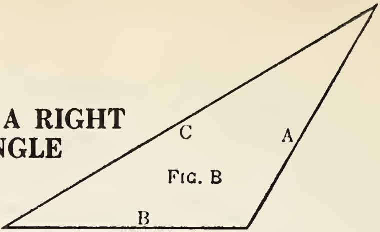


FIG. B

1. In the triangle (Fig. A) prove that $a^2 + b^2 = c^2$. What kind of triangle is Figure A? Why?

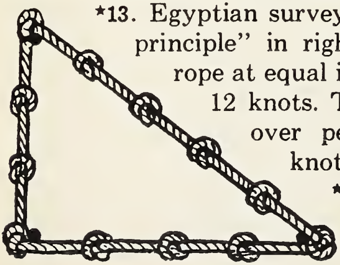
2. In the triangle (Fig. B) does $A^2 + B^2 = C^2$? Is Figure B a right triangle? Why or why not?

Examples 3–10 give the lengths of the sides of 8 triangles. Which of these triangles are right triangles? Why?

3. 6, 8, 10   5. 12, 16, 20   7. 16, 20, 24   9. 12, 21, 28
4. 4, 6, 8   6. 5, 12, 13   8. 7, 24, 25   10. 14, 48, 50

11. To form a right angle, carpenters often measure a board 6 feet long and another 8 feet long and fasten two ends together. Then the other two ends are fastened by a board 10 feet long. Show why a right angle is formed by this means.

*12. The distance between any two bases of a baseball diamond is 90 feet. Show how you could lay out a baseball diamond with a tape measure and three measuring sticks, 5 feet, 12 feet, and 13 feet in length. The angle at each base is, of course, a right angle.



*13. Egyptian surveyors made use of "the 3–4–5 principle" in right triangles. They knotted a rope at equal intervals until they had made 12 knots. Then they stretched the rope over pegs as shown. How many knots are on each side?

*14. Knot a 12-foot string at intervals of one foot. Lay out a right triangle by the Egyptian method.

SQUARE ROOT AND ITS MEANING

1. Esther was planning to buy a suitcase, inside length 24 inches, width 10 inches. She wanted to know whether her umbrella, 27 inches long, could be placed diagonally in the suitcase. Her brother said the umbrella would not fit in the case. Was he correct or not?

The case was rectangular in shape. Hence, the length of the diagonal can be found from the formula

$c^2 = a^2 + b^2 \quad c^2 = 576 + 100 = 676$

He knew that 26 × 26 = 676.

$c = 26$, no. of inches in the length of the diagonal.

Therefore Esther could not put an umbrella, 27 inches long, in a suitcase 10 inches by 24 inches.

In mathematics 26 is called the **square root** of 676 because 26 × 26 = 676.

The square root of a given number is the number which multiplied by itself produces the given number.

2. The square root of a number may be indicated by the sign $\sqrt{}$. Thus, $\sqrt{64}$ is read, "the square root of 64." What is $\sqrt{64}$?

3. A number whose exact square root can be found is called a **perfect square.** Hence, 25 is a perfect square, but 24 is not a perfect square. Why?

4. State which of the following numbers are perfect squares:

a. 1; *b.* 2; *c.* 4; *d.* 10; *e.* 12; *f.* 36; *g.* 50; *h.* 100.

5. Write the squares of all the numbers from 1 to 9, inclusive.

6. Ruth has a square piece of paper, 1 foot on a side. How many square inches does it contain?

FINDING SQUARES AND SQUARE ROOTS

On page 265 is a table showing the square and square root of every number from 1 to 150. The roots of numbers not perfect squares can only be approximated. In the table their values are given to the nearest hundredth.

1. Find the square of: *a*. 16; *b*. 68; *c*. 3.9; *d*. 108; *e*. 14.6; *f*. 1.37; *g*. 1.25; *h*. 1.08.

2. Find the square root of: *a*. 3; *b*. 14; *c*. 64; *d*. 92; *e*. 113; *f*. 140; *g*. 109; *h*. 147.

3. Find the square root of 1225. (HINT: Find 1225 in the column of squares. What is its square root?)

4. Find the square root of: *a*. 3364; *b*. 7396; *c*. 12,321; *d*. 16,900; *e*. 19,044; *f*. 12,996; *g*. 18,769.

5. Find the square root of 6.76.

The square root of 676 is 26. Therefore, the square root of 6.76 is 2.6. By inspection you can tell that the value must be between 2 and 3 because $2 \times 2 = 4$ and $3 \times 3 = 9$. 6.76 is between 4 and 9.

6. Find from the table on page 265 the square root of: *a*. 14.44; *b*. 33.64; *c*. 79.21; *d*. 1.1236; *e*. 1.6384; *f*. 190.44.

7. The side of a square is 7.8 inches. What is its area?

8. The area of a square is 46.24 square feet. What is its side?

*9. The perimeter of a square is 17.2 inches. What is its area?

*10. If the area of a circle is 81π, what is the radius?

*11. If the area of a circle is 144π, what is the radius? the diameter?

TABLE OF SQUARES AND SQUARE ROOTS

N	N²	√N	N	N²	√N	N	N²	√N
1	1	1.00	51	2,601	7.14	101	10,201	10.05
2	4	1.41	52	2,704	7.21	102	10,404	10.10
3	9	1.73	53	2,809	7.28	103	10,609	10.15
4	16	2.00	54	2,916	7.35	104	10,816	10.20
5	25	2.24	55	3,025	7.42	105	11,025	10.25
6	36	2.45	56	3,136	7.48	106	11,236	10.30
7	49	2.65	57	3,249	7.55	107	11,449	10.34
8	64	2.83	58	3,364	7.62	108	11,664	10.39
9	81	3.00	59	3,481	7.68	109	11,881	10.44
10	100	3.16	60	3,600	7.75	110	12,100	10.49
11	121	3.32	61	3,721	7.81	111	12,321	10.54
12	144	3.46	62	3,844	7.87	112	12,544	10.58
13	169	3.61	63	3,969	7.94	113	12,769	10.63
14	196	3.74	64	4,096	8.00	114	12,996	10.68
15	225	3.87	65	4,225	8.06	115	13,225	10.72
16	256	4.00	66	4,356	8.12	116	13,456	10.77
17	289	4.12	67	4,489	8.19	117	13,689	10.82
18	324	4.24	68	4,624	8.25	118	13,924	10.86
19	361	4.36	69	4,761	8.31	119	14,161	10.91
20	400	4.47	70	4,900	8.37	120	14,400	10.95
21	441	4.58	71	5,041	8.43	121	14,641	11.00
22	484	4.69	72	5,184	8.49	122	14,884	11.05
23	529	4.80	73	5,329	8.54	123	15,129	11.09
24	576	4.90	74	5,476	8.60	124	15,376	11.14
25	625	5 00	75	5.625	8.66	125	15,625	11.18
26	676	5.10	76	5,776	8.72	126	15,876	11.23
27	729	5.20	77	5,929	8.78	127	16,129	11.27
28	784	5.29	78	6,084	8.83	128	16,384	11.31
29	841	5.39	79	6,241	8.89	129	16,641	11.36
30	900	5.48	80	6,400	8.94	130	16,900	11.40
31	961	5.57	81	6,561	9.00	131	17,161	11.45
32	1,024	5.66	82	6,724	9.06	132	17,424	11.49
33	1,089	5.74	83	6,889	9.11	133	17,689	11.53
34	1,156	5.83	84	7,056	9.17	134	17,956	11.58
35	1.225	5.92	85	7,225	9.22	135	18,225	11.62
36	1,296	6.00	86	7,396	9.27	136	18,496	11.66
37	1.369	6.08	87	7,569	9.33	137	18,769	11.71
38	1,444	6.16	88	7,744	9.38	138	19,044	11.75
39	1,521	6.24	89	7,921	9.43	139	19,321	11.79
40	1,600	6.33	90	8,100	9.49	140	19,600	11.83
41	1,681	6.40	91	8,281	9.54	141	19,881	11.87
42	1,764	6.48	92	8,464	9.59	142	20,164	11.92
43	1,849	6.56	93	8,649	9.64	143	20,449	11.96
44	1,936	6.63	94	8,836	9.70	144	20,736	12.00
45	2,025	6.71	95	9,025	9.75	145	21,025	12.04
46	2.116	6.78	96	9,216	9.80	146	21,316	12.08
47	2,209	6.86	97	9,409	9.85	147	21,609	12.12
48	2,304	6.93	98	9,604	9.90	148	21,904	12.17
49	2.401	7.00	99	9,801	9.95	149	22,201	12.21
50	2,500	7.07	100	10,000	10.00	150	22,500	12.25

APPROXIMATE SQUARE ROOTS

1. From the table (page 265), find the approximate square root of 741.

741 is not in the table. But 741 is between 729 and 784, both of which are perfect squares and are in the table.

The $\sqrt{729}$ is 27, and the $\sqrt{784}$ is 28.

741 is less than halfway between 729 and 784; hence, the square root of 741 is between 27.0 and 27.5.

The squares of 27.1, 27.2, and 27.3 are shown.

$27.1^2 = 734.41$
$27.2^2 = 739.84$
$27.3^2 = 745.29$

The square root of 741, to the nearest tenth, is 27.2.

2. Between what two numbers in the table is 4513? To which of these numbers is it closer?

3. Between what two numbers in the table is 9337? To which of these numbers is it closer?

4. Between what two numbers in the table is 5838? To which of these numbers is it closer?

Find, to the nearest tenth, the square root of:

5. 483 6. 1865 7. 4343 8. 7000

*9. A square has an area of 163.84 square inches. What is the length of a side?

The side must be between 12 inches and 13 inches. Why? The exact value can be read from the table in the column of squares for three-place numbers.

*10. A square has an area of 210.25 square feet. What is the length of a side?

*11. Find, to the nearest tenth, the length of the side of a square which has an area of 154.36 square inches.

APPROXIMATE SQUARE ROOTS BY DIVISION

If you do not have a table of squares and square roots, you can find the approximate square root of a number by division.

1. Find by division the approximate square root of 1856.

The square root of 1856 is between 40 and 50, because $40^2 = 1600$ and $50^2 = 2500$.

As 1856 is nearer to 1600 than to 2500, try 43 as a divisor.

When 1856 is divided by 43, the quotient to the nearest hundredth is 43.16.

The approximate square root of 1856 is the average of the divisor and quotient, or

$$\begin{array}{r} 43.16 \\ 43\overline{)1856.00} \\ \underline{172} \\ 136 \\ \underline{129} \\ 70 \\ \underline{43} \\ 270 \\ \underline{258} \\ 12 \end{array}$$

$$\frac{43 + 43.16}{2} = \frac{86.16}{2} = 43.08$$

To the nearest tenth, the approximate square root is 43.1.

Check: $43.1 \times 43.1 = 1857.61$

2. If the square root to be found were midway between 40^2 and 50^2, what number would be used as a divisor?

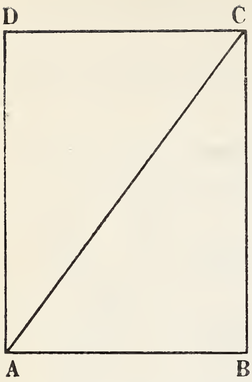
3. Between what two values is the square root of:

a. 72   *b.* 130   *c.* 790   *d.* 2732
e. 5144   *f.* 6198   *g.* 8950   *h.* 9124

Using the division method, find to the nearest tenth the approximate square root of each of the following numbers:

4. 50
5. 180
6. 670
7. 1340
8. 1492
9. 2131
10. 3285
11. 5100
12. 6000
13. 7025
*14. 80.34
*15. 24.27

FINDING THE HYPOTENUSE



1. A rectangle is 15 feet wide and 20 feet long. What is the length of its diagonal?

ABC is a right triangle.
$AC = H$ (Hypotenuse)
Then $H^2 = 15^2 + 20^2$. Why?
$H^2 = 225 + 400$. Explain.
$H^2 = 625$
$H = 25$. Explain.

2. A baseball diamond is 90 feet on a side. Find the distance between home plate and second base.

3. What is the distance between first and third bases?

4. A corner lot in a city is 100 feet square. How much shorter is it to walk diagonally across the lot than around two of the sides? (Express the result to the nearest foot.)

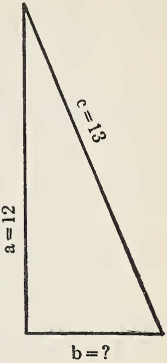
5. A school is located at the intersection of two roads. If Mary's home is 3 miles due north of the school, and Ethel's home is 4 miles due west of the school, what is the shortest distance between these two homes?

6. If the only way to travel from one home to the other (problem 5) is to pass the school, how much longer is this route than the airline route between the two homes?

7. To the nearest tenth, find the length of the diagonal of rectangles having the following dimensions:

	LENGTH	WIDTH		LENGTH	WIDTH		LENGTH	WIDTH
a.	14	8	*d.*	8	5	*g.*	5	3
b.	26	15	*e.*	16	9	*h.*	35	25
c.	25	20	*f.*	15	12	*i.*	72	54

*FINDING ANY SIDE OF A RIGHT TRIANGLE



1. In the triangle shown, you know that $c^2 = a^2 + b^2$. Write the formula for b^2; for a^2.

2. The hypotenuse of a right triangle is 13 inches and one of the legs is 12 inches. How long is the other leg?

Let $c = 13$ $\quad b^2 = c^2 - a^2$, the formula
$a = 12$ $\quad b^2 = 13^2 - 12^2$
$b = ?$ $\quad b^2 = 169 - 144$, or 25
$b = 5$. Explain.
The missing dimension is 5 inches.

3. The hypotenuse of a right triangle is 10 feet and one leg is 8 feet. How long is the other leg?

4. If a and b are the legs and c the hypotenuse of a right triangle, find the missing values in the following triangles:

	5.	**6.**	**7.**	**8.**	**9.**	**10.**
$a =$	6	?	12	?	10	?
$b =$	8	5	?	10	10	24
$c =$	?	13	16	20	?	30

11. The altitude of an isosceles triangle bisects its base. If the equal sides of the triangle are 14 inches and the base is 8 inches, what is the altitude of the triangle? the area?

***12.** Select the best answer to the following puzzle: A flat surface is 1 mile in length. At each end of the surface is fastened the end of a string 1 foot longer than the surface (5281 feet). If the middle of the string is raised vertically above the surface until the string is taut, the highest point on the string above the surface is:

a. 6 in.; *b.* 1 ft.; *c.* 6 ft.; *d.* 50 ft.; *e.* 100 ft.

HOW WELL DO YOU REMEMBER?

1. What is the ratio of 3 feet to 6 feet? of 6 feet to 3 feet?

2. Write the ratio of $5 to $8 in two different ways.

3. What is the ratio of the side of a square to the perimeter? of the perimeter to a side?

4. When new potatoes sell at 3 pounds for 14¢, find the cost of 1 peck (15 pounds).

5. If Sam can read 5 pages in 8 minutes, how long will it take him to read 40 pages at the same rate?

6. What is meant by "divine proportion"? Which of the following rectangles has the ratio of its sides most nearly approaching the Greek ideal: *a.* 9′ × 12′? *b.* 8′ × 10′? *c.* 6′ × 10′? *d.* 5′ × 6′? *e.* 11″ × 19″?

7. If a map is drawn to a scale 1″ = 50 miles, find the distance between two cities, $2\frac{1}{2}$ inches apart on the map.

8. A blueprint is made to the scale 1″ = 16′. Find the dimensions on the blueprint of a building lot 50′ × 120′.

9. At a distance of 100 feet from the foot of a flagpole, the angle of elevation of the top of the pole is 30°. By a scale drawing, find the height of the flagpole.

10. State which of the following represent the sides of a right triangle: *a.* 3, 4, 5; *b.* 7, 9, 10; *c.* 7, 24, 25.

11. Square each number: 1, 9, 10, 16, 33, 99.

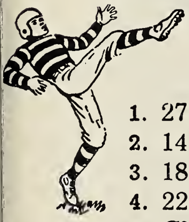
12. Copy the following sentence and insert the missing numbers: The square of a one-figure number contains either ? or ? figures; the square of a two-figure number contains either ? or ? figures.

13. How many figures are in the square root of: *a.* 9? *b.* 144? *c.* 9025? *d.* 11,025? *e.* 64? *f.* 122,500?

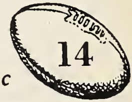
USING THE VOCABULARY OF ARITHMETIC

Define each term given below or use it correctly in a sentence. If you do not know the meaning of a term, turn to the key page in parentheses.

angle of elevation	(258)	legs of a right triangle	(261)
direct measurement	(257)	ratio	(247)
divine proportion	(252)	perfect square	(263)
indirect measurement	(257)	square root	(263)
hypotenuse rule	(261)	scale drawing	(255)



LET'S PRACTISE



	a	*b*	*c*
1.	27.5% of 360	$\frac{1}{2}$% of 1450	155% of 390
2.	14 = ? % of 70	35 = ? % of 210	150 = ? % of 25
3.	18 = 12% of ?	100 = 40% of ?	5 = 5% of ?
4.	225% of 360	420 = ? % of 560	30 = 2% of ?

5. Change to per cents: *a.* $\frac{1}{8}$; *b.* .01; *c.* 4; *d.* $2\frac{1}{2}$.

6. Change to decimals: *a.* 8%; *b.* $\frac{1}{2}$%; *c.* 90%; *d.* 110%.

7. To the nearest hundredth, find the value of: *a.* $\frac{6}{7}$; *b.* $\frac{7}{9}$; *c.* $\frac{5}{8}$; *d.* $\frac{3}{11}$; *e.* $\frac{5}{16}$; *f.* $\frac{2}{9}$.

*TOPICS FOR SPECIAL REPORTS

1. Show how a housewife uses ratios in following recipes.

2. Make a scale drawing of your classroom.

3. Show how indirect measurement is used in: *a.* astronomy; *b.* warfare; *c.* navigation.

4. Draw three right triangles of different sizes, each containing an acute angle of 31°. Find the ratio of the legs in each triangle and see if these ratios are the same.

5. Show that the sum of the odd numbers in order, beginning with 1 + 3, will always be a perfect square.

THINGS TO REMEMBER

1. *What ratio is and how to use it.*

2. *How to copy figures to a given scale.*

3. *How to find heights and other unknown dimensions by indirect measurement.*

4. *How to find the approximate square root of any number.*

5. *How to use the Pythagorean rule.*

TEST ON CHAPTER XII

1. Find the ratio between: *a.* 3 yards and 8 yards; *b.* 6 inches and 2 feet; *c.* 45 minutes and 2 hours.

2. The distance between bases on a baseball diamond is 90 feet. What is the ratio of the distance between any two bases and the distance around the diamond?

3. If 4 oranges cost 23¢, how much will 24 oranges cost at the same rate?

4. A baseball team played 14 games and won 9. What was the ratio of the number of games won to the number of games lost? of the number of games lost to the number of games won?

5. Morton found the picture of a gnu in his dictionary. The fraction, $\frac{1}{45}$, was written below the picture. What did the fraction represent?

6. The floor of the basketball court in the Y.M.C.A. Gym measures 50′ × 80′. Make a scale drawing of the floor using the scale 1″ = 8′.

7. What is a 3–4–5 triangle? What kind of a triangle is it?

8. Two triangles have sides: *a.* 5 in., 12 in., 13 in.; *b.* 6 in., 9 in., 12 in. Which is a right triangle? Why?

9. To the nearest tenth, find the approximate square root of 41.

PROGRESS TEST

Solve the following problems. Then have your paper scored. If you made errors on the test, turn to the key pages in parentheses for help.

1. To three decimal places, find the standing of a baseball team which played 35 games and won 19. (27)

2. A grocer bought a crate containing 216 oranges for $3.60. If he sold the oranges at 40¢ a dozen, what was his margin? (83)

3. The grocer's expenses (problem 2) were 15% of his sales. What was his profit? The profit was what per cent of the selling price? (83)

4. A certain postage stamp measures 0.75″ × 0.87″. What are the dimensions of a rectangular sheet of 100 such stamps, if there are 10 stamps on each edge of the sheet? (21)

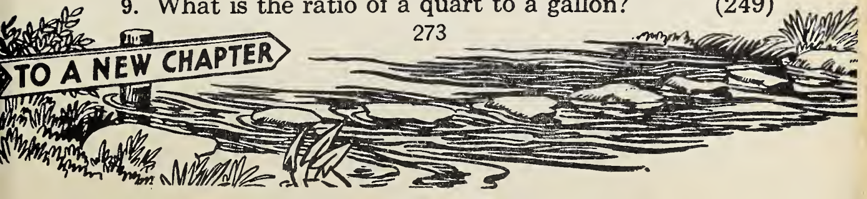
5. A mortgage of $6500 is to be repaid in $18\frac{1}{2}$ years at the rate of $47 a month. The amount paid in monthly instalments is how much greater than the amount of the loan? (135)

6. A farmer delivered 4530 bushels of wheat to an elevator. The shrinkage was 30 lb., and the dockage was 60 lb. If the wheat was worth $1.15 a bushel, what was the value of the cash ticket he received? (198)

7. Hidden taxes represent at least 25% of the cost of many purchases. At that rate, find the amount of the hidden taxes on a suit which cost $37. (65)

8. A property, worth $6500, is assessed at 60% of its value. At a tax rate of $2.19 on $100, find the annual tax on the property. (187)

9. What is the ratio of a quart to a gallon? (249)



CHAPTER XIII

INCREASING YOUR KNOWLEDGE OF ALGEBRA

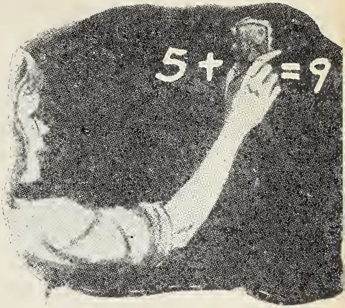
Harry had twice as much money as Robert and together they had \$2.25. How much money had each?

SOLVE BY ARITHMETIC	SOLVE BY ALGEBRA
If Harry had twice as much money as Robert, then Harry had $\frac{2}{3}$ of the amount which both had, and Robert had $\frac{1}{3}$. **$\frac{1}{3}$ of \$2.25 = \$0.75** **$\frac{2}{3}$ of \$2.25 = \$1.50**	**Let x = number of cents Robert had** **and $2x$ = number of cents Harry had** **Then $3x = 225$** **(since \$2.25 = 225¢)** **$x = 75$** **$2x = 150$** **Robert had \$0.75** **Harry had \$1.50**

Which do you think is the easier way of solving the problem: by arithmetic or by algebra? Why?

To solve problems by algebra, you must become familiar with the tools of algebra. In your study of the formula you learned how letters are used to represent numbers. One of the very useful tools of algebra is the **equation.** In this chapter you will learn more about equations and how to use them in solving problems.

FINDING A MISSING NUMBER



Joan wrote three numbers on the blackboard and covered one of the numbers with a board eraser. Then she asked the class to tell what number was missing.

Bill said, "We must think, 'What number added to 5 will give 9?' This number is 4."

Find the missing numbers:

1. $5 + ? = 12$
2. $7 + ? = 15$
3. $? + 10 = 16$
4. $20 = 12 + ?$
5. $3 \times ? = 24$
6. $36 = ? \times 9$
7. $9 \times ? = 81$
8. $5 - ? = 3$
9. $? - 4 = 13$
10. $\frac{?}{3} = 8$
11. $10 = \frac{?}{4}$
12. $\frac{?}{7} = 9$

Instead of using a question mark to represent the missing number, the class decided to let n stand for the number to be found.

Walter wrote: $n + 3 = 9$. "In your example, Walter," said Joan, "n stands for 6, because $6 + 3 = 9$."

Find the value of n in each of the following:

13. $3n = 12$
14. $8n = 24$
15. $n + 7 = 9$
16. $n + 1 = 12$
17. $n - 6 = 8$
18. $n - 9 = 30$
19. $\frac{1}{2}n = 5$
20. $\frac{1}{4}n = 8$
21. $n - 5 = 20$
22. $6n = 42$
23. $n + 4 = 18$
24. $\frac{1}{5}n = 6$
25. $n - 1 = 9$
26. $n + 1 = 9$
27. $\frac{1}{3}n = 4$
28. $\frac{1}{5}n = 2$
29. $5 = n + 1$
30. $18 = 2n$

Statements, as in examples **13-30**, are called **equations.**

An equation shows that two things are equal. At least one of the numbers in an equation is represented by a letter. The equation, $n + 4 = 7$, shows that "$n + 4$" and "7" are equal, and the missing number is represented by the letter "n."

THE LANGUAGE OF ALGEBRA

When you begin to study a new subject, you must learn the vocabulary, or language, of that subject. Algebra has its language. In algebra, for example, you may use n, x, or any other letter to represent a number. Read each of the following statements. Then note how the words of each statement are changed into the language of algebra.

Statement	Algebraic Form
1. Twice a number increased by 5.	$2n + 5$
2. A number decreased by 4.	$n - 4$
3. Half of a number increased by 3.	$\frac{1}{2}n + 3$
$\left(\frac{n}{2}\right.$ and $\frac{1}{2}n$ are the same$\left.\right)$	or $\frac{n}{2} + 3$

Write in the language of algebra: (Let n represent the number for problems 4-10; x, for problems 11-18.)

4. Four times a number.
5. A number increased by 8.
6. A number decreased by 6.
7. Four times a number increased by 12.
8. Ten times a number decreased by 2.
9. One third of a number.
10. Half of a number decreased by 5.
11. One fourth of a number increased by 7.
12. A number plus twice the number.
13. Twice a number decreased by 14.
14. Half of a number increased by 16.
15. Three times a given amount increased by 4.

*16. A number plus one third of the number.

*17. A number decreased by one fourth of the number.

*18. Half of a number decreased by one third of the number.

BUILDING EQUATIONS

In the following statements one thing is equal to another thing, so the statements may be written as equations.

Statement	Equation
1. A number increased by 9 is 14.	$n + 9 = 14$
2. Twice a number decreased by 4 is 6.	$2n - 4 = 6$
3. Half of a number increased by 5 is 11.	$\frac{1}{2}n + 5 = 11$

Write equations for the following:

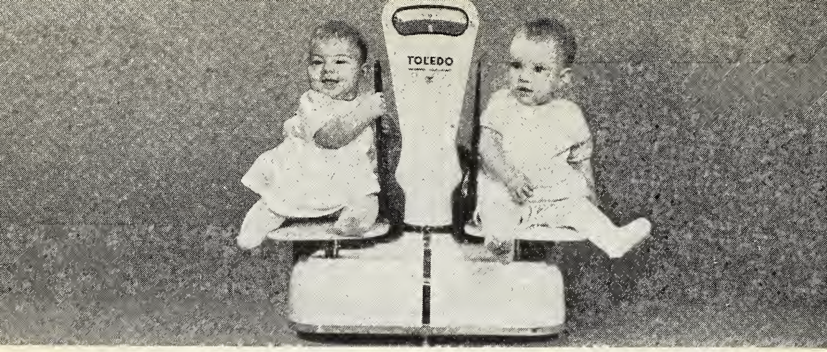
4. A number decreased by 6 is 10.
5. A number multiplied by 3 is 24.
6. A number divided by 6 is 3.
7. Four times a number decreased by 5 is 15.
8. If 4 is taken from a number, the remainder is 12.
9. Five times a number increased by 6 is 21.
10. Three times a number less 4 is 24.
11. Five times a number less 15 is zero.
12. One fourth of a number is 8.
13. Half of a number less 3 is 5.
14. One third of a number plus 1 is 13.
15. Twelve is equal to a number plus 4.
16. Two is equal to twice a number less 3.
17. What number divided by 4 is equal to 6?
18. What number decreased by 3 is equal to 8?

*19. One third of a number less one fourth of it is 1.

*20. Half of a number plus one fourth of it is 6.

*21. Twice a number decreased by 7 is equal to the number itself.

*22. One third of a number increased by 6 is equal to five times the number.



PROPERTIES OF EQUATIONS

Just as balance scales have two pans, one on either side of the centre support, so equations have two parts, called **members,** one on either side of the sign of equality. **Both members of an equation are equal.**

In the equation, $x + 4 = 7$, one member is "$x + 4$," and the other is "7."

Read each member in each of the following equations: *a.* $n - 6 = 15$; *b.* $23 = 2y - 5$; *c.* $\frac{b}{6} = 4$; *d.* $36 = 4z + 5$.

When one member of an equation is changed, the other member must be changed in like manner.

Certain rules or **axioms** govern work with equations.

a. **If equals are added to equals, the sums are equal.**

b. **If equals are subtracted from equals, the remainders are equal.**

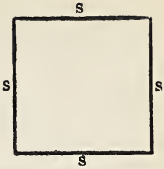
c. **If equals are multiplied by equals, the products are equal.**

d. **If equals are divided by equals, the quotients are equal.**

These four rules may be combined into one rule which may be called the **Golden Rule of Equations:**

Whatever you do to one member of an equation, you must do to the other also.

SOLVING EQUATIONS BY THE DIVISION RULE



1. The perimeter of a square is 24 inches. What is the length of a side?

The formula for the perimeter of a square is $p = 4s$. By substituting 24 for p, we get the equation

$$24 = 4s$$

Divide both members by 4. This gives $\frac{24}{4} = \frac{4s}{4}$,

or $6 = s$

The length of a side is 6 inches. Check: $24 = 4 \times 6$

Solve and check the following equations:

2. $2n = 18$
3. $54 = 9y$
4. $210 = 5r$
5. $5a = 45$
6. $72 = 9t$
7. $2g = 81$
8. $7c = 42$
9. $4m = 92$
10. $3x = 55$
11. $8x = 56$
12. $7a = 133$
13. $8y = 1.68$

14. If three quarts of milk cost 42¢, what is the cost of one quart?

Let $x =$ the cost of one quart
The equation $3x = 42$
Dividing both members by 3, $x = 14$
The cost was 14¢ a quart. Check: $3 \times 14 = 42$

To solve problems by algebra, proceed as follows:

a. **Find what is asked in each problem.**
b. **State the problem in the form of an equation.**
c. **Solve the equation. Then check it.**

15. At what rate an hour must a car travel in order to go a distance of 140 miles in 4 hours?

SOLVING EQUATIONS BY THE SUBTRACTION RULE

1. The length of a rectangle is 5 feet greater than the width. If the length is 8 feet, what is the width?

Let $w =$ **no. of feet in width**
and $w + 5 =$ **no. of feet in length**
Then, the equation $w + 5 = 8$
Subtract 5 from both members $\underline{\quad 5 = 5}$
This gives $w \quad = 3$
The width is 3 feet.
Check: 3 + 5 = 8, substituting 3 for *w*.

Solve and check the following equations:

2. $x + 12 = 20$
3. $n + 3 = 10$
4. $a + 13 = 20$
5. $y + 1\frac{1}{2} = 6$
6. $9 + x = 10$
7. $t + 9 = 9$
8. $23 = 15 + k$
9. $n + 3.6 = 13$
10. $13 = 6 + r$
11. $24 = 18 + s$
12. $n + 2\frac{3}{4} = 7$
13. $n + 5.1 = 11.2$

14. There are 5 more boys than girls in a class. If there are 19 boys, find the number of girls.

15. Henry has 3 more dimes than nickels. If he has 7 nickels, how many dimes does he have?

16. A farmer had 12 more Holstein cows than Jersey cows. He had 33 Holstein cows. How many Jerseys had he?

17. On a street there are 9 more elm trees than maple trees. If there are 12 elm trees, what is the number of maples?

18. Jane has 143 more stamps than Alice has. If Jane has 927 stamps, how many does Alice have?

19. Mr. Rice's salary is \$175 more this year than last year. If his present salary is \$1825, what was his salary last year?

SOLVING EQUATIONS—MULTIPLICATION RULE

1. If a quarter pound of cheese costs 8¢, find the cost of one pound at the same rate.

Let $x =$ the cost of one pound
Then $\frac{x}{4}$ or $\frac{1}{4}x$ $\left(\frac{x}{4} = \frac{1}{4}x\right)$ = the cost of $\frac{1}{4}$ of a pound
The equation $\frac{x}{4} = 8$
Multiply both members by 4 ${}^{1}\cancel{4} \times \frac{x}{\cancel{4}_{1}} = 4 \times 8$
This gives $x = 32$
The cost was 32¢ a pound. Check: $32 \div 4 = 8$

Solve and check the following:

2. $\frac{m}{4} = 6$
3. $\frac{r}{9} = 7$
4. $\frac{y}{10} = .1$
5. $\frac{x}{5} = 9$
6. $\frac{x}{3} = 4\frac{1}{3}$
7. $\frac{y}{4} = 5.3$
8. $\frac{s}{4} = 15$
9. $\frac{x}{2} = 0$
10. $54 = \frac{n}{3}$
11. $\frac{t}{2} = 4.8$
12. $4 = \frac{p}{5}$
13. $\frac{m}{100} = 8.7$

14. A farmer sold $\frac{1}{3}$ of his crop of oats for $175. At that rate, what was the value of the whole crop?

15. A family spends $\frac{1}{5}$ of its income for rent. If the rent is $45 a month, what is the monthly income?

16. One eighth of a number is 27. What is the number?

17. Mr. Scott paid his income tax in quarterly payments. If each payment was $34.58, what was his total income tax?

★18. Mrs. Martin bought a refrigerator on the instalment plan. If her monthly payment was $16 for 8 months, what was the cost of the refrigerator? (Each payment = $\frac{1}{8}$ of cost.)

★19. Mrs. Reed bought a car on the instalment plan. She made a cash payment and the remainder in 12 equal monthly instalments of $48.50. What was the amount paid in monthly instalments?

SOLVING EQUATIONS BY THE ADDITION RULE

1. A dealer in used cars sold 6 cars in one week and then had 15 cars left. How many cars did he have at the beginning of the week?

Let $x =$ the number of cars he had at first
and $x - 6 =$ the number of cars remaining after 6 were sold
The equation $x - 6 = 15$
Add 6 to both members of the equation $\underline{\phantom{x - {}}6 = 6}$
This gives $x = 21$
The dealer had 21 cars.
Check: $21 - 6 = 15$, substituting 21 for x.

Solve and check the following:

2. $x - 4 = 13$
3. $24 = y - 7$
4. $h - 6 = 0$
5. $r - .7 = 1.5$
6. $y - 8 = 17$
7. $54 = n - 9$
8. $z - 2 = 3\frac{1}{2}$
9. $p - 1.5 = 7.5$
10. $m - 6 = 35$
11. $19 = x - 1$
12. $h - 2\frac{1}{4} = 4\frac{1}{2}$
13. $y - 2.5 = 0$

14. Jim sold his knife for 40¢, which was 35¢ less than he paid for it. Find the cost.

15. At the close of a football game, one of the players weighed 174 pounds. He had lost 6 pounds during the game. What was his weight before the game?

16. A farmer sold some wheat for 72¢ a bushel, which was 12¢ below the market price a month later. What was the market price on the later date?

17. After Milton spent $2.85 for a pair of skates, he had $1.96 left. How much did he have at first?

USING MULTIPLICATION AND DIVISION RULES

In some equations, both the multiplication and division rules must be used to complete the solution.

1. If $\frac{3}{4}$ of a pound of butter costs 27¢, find the cost of one pound at the same rate.

Let $x =$ **the cost of one pound**

Then $\frac{3x}{4} =$ **the cost of $\frac{3}{4}$ of a pound**

The equation $\frac{3x}{4} = 27$

Multiplying both members by 4 $3x = 108$

Dividing both members by 3 $x = 36$

The cost is 36¢ a pound. Check: $\frac{3}{4}$ of 36¢ = 27¢.

Solve the following equations:

2. $\frac{2x}{3} = 10$
3. $\frac{3h}{2} = 10$
4. $\frac{9x}{4} = 36$
5. $\frac{9y}{10} = 90$
6. $\frac{3a}{5} = 12$
7. $\frac{5b}{2} = 12$
8. $\frac{2n}{3} = 15$
9. $\frac{2h}{5} = 15$
10. $\frac{4n}{7} = 8$
11. $\frac{7n}{8} = 14$
12. $12 = \frac{3x}{4}$
13. $36 = \frac{2a}{3}$

14. If $\frac{3}{4}$ of a yard of ribbon costs 18¢, what is the cost of one yard?

*15. If $1\frac{1}{2}$ pounds of steak cost 54¢, what was the cost of one pound? ($1\frac{1}{2} = \frac{3}{2}$)

*16. If $3\frac{1}{2}$ yards of ribbon cost $1.05, what was the price of one yard?

*17. If $1\frac{3}{4}$ gallons of anti-freeze for the radiator of an automobile cost $3.50, what is the cost of one gallon?

*18. The cost of $2\frac{3}{4}$ yards of cloth for a dress was $3.30, What was the cost of one yard?

FINDING A MISSING LETTER IN A FORMULA

1. Martha's garden is rectangular and contains 36 square feet. If the garden is 9 feet long, how wide is it?

Formula for area of a rectangle: $A = lw$
Substituting the given values in the formula: $36 = 9w$
Dividing both members by 9: $4 = w$
The width is 4 feet. Check: $36 = 9 \times 4$.

Find the missing dimensions in these rectangles:

2. $A = 24$ sq. ft., $l = 6$ ft., $w = ?$
3. $A = 90$ sq. ft., $w = 6$ ft., $l = ?$
4. Find the altitude of a triangle which has a base of 9 inches and an area of 36 square inches.

Formula for area of a triangle: $A = \frac{bh}{2}$
Substituting the given values in the formula: $36 = \frac{9h}{2}$
Multiplying both members by 2: $72 = 9h$
Dividing both members by 9: $8 = h$
The altitude is 8 inches. Check: $36 = \frac{1}{2} \times 9 \times 8$.

Using the formula $A = \frac{1}{2}bh$, find the missing letters:

	5.	6.	7.	8.	9.	10.
$A =$	12	15	48	56	?	72
$b =$	6	5	?	7	9	6
$h =$	?	?	12	?	12	?

*11. Using the formula $C = \pi d$, if $C = 22$, find d; if $C = 154$, find d. ($\pi = \frac{22}{7}$)

*12. Using the formula $V = lwh$, if $V = 144$, $l = 8$, and $w = 6$, find h.

PRACTICE IN SOLVING EQUATIONS

Set I

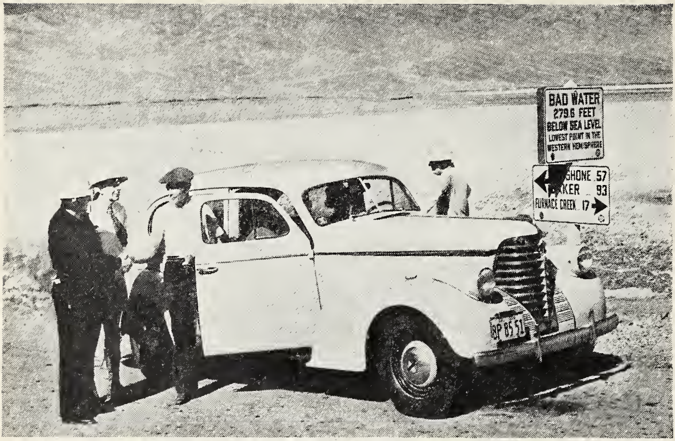
1. $x - 3 = 5$
2. $n + 8 = 12$
3. $b - 15 = 18$
4. $40 = 8a$
5. $\frac{y}{4} = 20$
6. $5x = 60$
7. $\frac{a}{4} = 15$
8. $3 = \frac{m}{4}$
9. $720 = 5c$
10. $90 = 4s$
11. $72 = 4a$
12. $36 = \frac{y}{5}$
13. $15 = x + 6$
14. $a + 40 = 50$
15. $n - 18 = 31$

Set II

1. $5x = 80$
2. $3.68 = 8x$
3 $\frac{n}{7} = 18$
4. $\frac{5r}{6} = 30$
5. $p + 3\frac{1}{4} = 12\frac{1}{2}$
6. $n - 3\frac{1}{2} = 2\frac{1}{4}$
7. $a + 2\frac{1}{3} = 4\frac{5}{6}$
8. $\frac{2n}{3} = 8$
9. $\frac{4s}{5} = 20$
10. $\frac{2a}{5} = 40$
11. $n + 5\frac{1}{2} = 7$
12. $6p = 5.4$
13. $\frac{3t}{4} = 15$
14. $\frac{6h}{7} = 24$
15. $72 = \frac{3r}{4}$

Set III

1. Use the formula for the area of a rectangle:
   a. If $A = 72$ and $l = 16$, find w.
   b. If $A = 216$ and $w = 9$, find l.
2. Use the formula for the area of a triangle:
   a. If $A = 48$ and $h = 16$, find b.
   b. If $A = 72$ and $b = 18$, find h.
3. Use the formula for the volume of a prism:
   a. If $V = 144$, $l = 8$, and $w = 3$, find h.
   b. If $V = 360$, $l = 8$, and $h = 6$, find w.
4. Use the formula for the volume of a pyramid:
   a. If $V = 36$ and $B = 12$, find h.
   b. If $V = 120$ and $h = 18$, find B.
5. Use the formula for the area of a square:
   a. If $A = 625$, find s.
   b. If $A = 1296$, find s.


BAD WATER
279.6 FEET
BELOW SEA LEVEL
LOWEST POINT IN THE
WESTERN HEMISPHERE
SHONE 57
KER 93
FURNACE CREEK 17

DEATH VALLEY—MT. WHITNEY

The car in the upper picture is at Bad Water in Death Valley, California. Read the road signs.

The picture (page 287) shows the same car at the end of the road, 8371 feet up Mt. Whitney.

The road sign might have read, "Bad Water, −279.6 feet." The elevation above sea level of the end of the road on Mt. Whitney might be written +8371 feet.

The **minus sign** before 279.6 indicates that the place is **below sea level**; the **plus sign** before 8371 indicates that the place is **above sea level.**

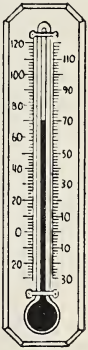
Write 50 feet below sea level; 5000 feet above sea level.

Readings of temperature from a thermometer may also be written with plus or minus signs. When you say that the temperature of your classroom should be 70°, you mean 70° above zero. This may be written +70°.

Very often the plus sign is omitted before a positive number. The minus sign must always be written.

1. Using plus to represent above zero, and minus to represent below zero, write:

a. 25° above zero
b. 14° below zero
c. 95° above zero
d. 3° above zero
e. 1° below zero
f. 1° above zero
g. 65° above zero
h. 10° below zero



2. The freezing point for water is 32° above zero. Write this temperature. Did you choose the plus or the minus sign?

3. Write the temperature when the thermometer registers zero degrees.

When the **plus sign** is written before a number, the number is a **positive number.** When the **minus sign** is written before a number, the number is a **negative number.** Positive and negative numbers are called **signed numbers.**

NUMERICAL OR ABSOLUTE VALUE

You found (page 287) that positive and negative numbers are called signed numbers. The amount of change between two numbers is the **numerical** or **absolute value** of the signed numbers. Thus, a change in temperature from 40° to 50° is 10°. This change is positive because it shows that the temperature rose 10°.

A change in temperature from 45° to 35° is 10°. This change is negative because it shows that the temperature dropped 10°. In each case the change is 10°.

When the temperature goes up 10°, the amount of the change is +10°; when the temperature goes down 10°, the amount of the change is −10°. Thus, both +10° and −10° have the numerical or absolute value of 10°; but the signs tell that these amounts are in opposite directions.

The numerical or absolute value of a signed number is the number without the sign.

1. What is the numerical or absolute value of +16? of −3? of +40? of −1? of −16°? of +3°? of +1°?

2. Write as signed numbers:

a. positive 6	*d.* negative 1
b. negative 30	*e.* positive 100°
c. positive 1	*f.* negative 20°

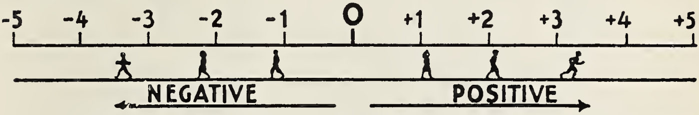
3. Mr. Smith earned $24 one week and $30 another week. What is the absolute difference between the two amounts? Consider earning as positive and write this difference with a signed number.

4. A football team advanced the ball 4 yards by rushing; then a forward pass gained 12 yards more. Write the total gains with a signed number.

5. A football team gained 5 yards and then lost 5 yards by a penalty. Write these amounts with signed numbers.

SIGNED NUMBERS ON A HORIZONTAL SCALE

A scale in a horizontal position may also be used to indicate signed numbers. Numbers to the left of a zero point usually are considered negative and those to the right positive.



1. If you walk 1 mile in a positive direction and then walk 2 miles more in the same direction, how far do you walk? Indicate your position on the scale.

2. If you walk 2 miles in a negative direction and then go 1 mile more in that direction, how far do you walk? Indicate your position on the scale.

3. If you walk 4 miles in a positive direction and then walk 1 mile in a negative direction, how many miles do you walk? Indicate your position on the scale. You are now how far from your starting position?

4. If you walk 2 miles in a positive direction and then 2 miles in a negative direction, how far do you walk? Indicate your position on the scale.

5. When +2 and −2 are added the result is zero. Zero does not have the same meaning when used with signed numbers that it has in arithmetic. Zero used with signed numbers means that there has been **no change.** If you gain 3 pounds in weight and then lose 3 pounds, you are back to your original weight. What does zero mean in this case?

6. Show how you could represent a gain of 3 pounds and then a loss of 3 pounds on the number scale given above.

HOW WELL DO YOU REMEMBER?

1. Using n to represent the number, write the following statements in the language of algebra: *a.* five times a number; *b.* a number decreased by 6; *c.* a number increased by 8; *d.* one third of a number.

2. Using x to represent the number, make equations from the following statements: *a.* three more than a number is 8; *b.* half of a number is 7; *c.* a number decreased by 5 is 9; *d.* four times a number is 28.

3. Solve the equations which you made in problem 2.

Solve and check the following:

4. $x - 5 = 8$
5. $\frac{x}{9} = 12$
6. $a - 43 = 5$
7. $n + 3 = 15$
8. $7x = 84$
9. $\frac{2a}{3} = 12$
10. $14 = 8 + n$
11. $56 = 8a$
12. $\frac{3a}{4} = 72$

13. Using the formula $A = bh$: if $A = 56$ and $b = 8$, find h.

14. Using the formula $V = lwh$: if $V = 360$, $l = 12$, and $h = 6$, find w.

15. Using the formula $A = \frac{1}{2}bh$: if $A = 24$, and $h = 8$, find b.

16. Express the following as signed numbers: *a.* a gain of 15¢; *b.* a loss of 25¢; *c.* 6° below zero.

17. Robert saw an advertisement which stated that 1 gallon of antifreeze will protect the radiator of an automobile to a temperature of −20°. What is meant by −20°?

18. Give the absolute value of the following: *a.* +3; *b.* −14; *c.* +65; *d.* −4°.

19. In scoring a game John said he was 500 "in the hole." Using signed numbers, how could he have stated his score?

20. What does zero mean in signed numbers?

THINGS TO REMEMBER

1. *How to write a statement in the language of algebra.*
2. *How to make an equation.*
3. *How to solve certain kinds of equations.*
4. *How to solve for a missing letter in a formula.*
5. *The meaning and some uses of signed numbers.*

TEST ON CHAPTER XIII

1. Using n to represent the number, write the following statements in the language of algebra: *a.* a number decreased by 5; *b.* three times a number; *c.* a number increased by 12.

2. Using y to represent the number, write equations for the following: *a.* six times a number is 48; *b.* a number decreased by 6 is 8; *c.* a number increased by 3 is 15; *d.* three fourths of a number is 18.

3. Solve the equations you made in problem 2.

4. Using the formula $p = 4s$, if $p = 64$, find s.

5. Using the formula $A = bh$; if $A = 96$ and $b = 12$, find h.

6. Using the formula $V = Bh$; if $V = 216$ and $h = 9$, find B.

7. If gain is positive and loss is negative, write with signed numbers a gain of \$5 and a loss of \$3.

8. If a football team gains 9 yards and is then penalized 5 yards, what is the net gain? Using signed numbers, write the given amounts.

9. What is the absolute value of -5? of $+16$? of $-10°$?

10. The temperature one evening was two degrees below zero; the next morning it was five degrees below zero. Write these amounts as signed numbers. How much colder was it in the morning than on the previous evening?

PROGRESS TEST IN PROBLEM SOLVING

Solve the following problems and have your paper marked. If you made errors on this test, turn to the key pages in parentheses for help.

1. In a class of 25 students there are 14 girls. What per cent of the class is girls? is boys? (66)

2. If the base of a triangle is 12 inches and its altitude is 9 inches, what is its area? (40)

3. Find the volume of a cylinder 14 feet in diameter and 36 feet high. (Use $\pi = \frac{22}{7}$) (232)

4. A suit was sold for $36 at a margin of 35% of the selling price. What was the cost of the suit? (84)

5. Using s to represent the side, write the formula for the perimeter of an equilateral triangle; of a regular pentagon; of a regular hexagon. (42)

6. How many days are in the interval from March 15 to July 1? (119)

7. What is the difference between the tax on two quarter-sections of land, one assessed at $25 an acre with a rate of 24 mills, the other assessed at $30 an acre with a rate of 22 mills? (187)

8. Two numbers are in the ratio of 5 : 6. If the larger number is 54, what is the smaller number? (250)

9. Find the cost of 20 grapefruit at 5 for 23¢. (250)

10. At a distance of 75 feet from the base of a chimney, the angle of elevation of the top is 34°. By scale drawing, find the height of the chimney. (258)

11. A man had a yearly income of $360 from money invested at 3%. How much did he have invested at that rate? (74)

12. The edge of a cube is 4 inches. What is the volume of the cube? (229)

PROGRESS TEST

Perform the indicated operations. If you make errors, turn to the key pages in parentheses where the work is explained.

1. $7\frac{2}{3} + 1\frac{5}{6} + 3\frac{1}{2} + 9\frac{1}{4} = ?$ (14)
2. $7000 - 1092 = ?$ (8)
3. $2534 \div 29 = ?$ (12)
4. $.5616 \div 5.4 = ?$ (22)
5. From $7\frac{1}{8}$ subtract $3\frac{5}{6}$. Check your solution. (14)
6. $56 \times 438 = ?$ (9)
7. $9.6 \times 2.04 = ?$ (21)
8. $3\frac{1}{4} \times 4\frac{1}{2} = ?$ (16)
9. $2.405 - 0.958 = ?$ (20)
10. If 30% of a number is 45, what is the number? (74)
11. 3% of \$750 = ? (65)
12. $\frac{1}{2}$% of \$1450 = ? (72)
13. 100 = ? % of 40 (66)
14. 1 = ? % of 200 (66)
15. 5 is 2% of ? (74)
16. 42 is 10% of ? (74)
17. Round off the following to the nearest hundred: *a*. 638; *b*. 14,376; *c*. 50,999; *d*. 449. (26)
18. Square: *a*. 76; *b*. 4.5; *c*. .25. (264)
19. Find the interest on \$450 at 4% for 36 days. (107)
20. Find A in the formula $A = \frac{1}{2}h\,(a + b)$ when $h = 16$, $a = 15$, and $b = 24$. (47)
21. Find the approximate square root of 1524. (266)
22. Draw a line 3 inches long and bisect it. (205)
23. What number multiplied by itself equals 225? (265)
24. Solve and check the equation $\frac{2x}{3} = 24$. (283)
25. In the formula $V = Bh$, if $V = 120$ and $B = 24$, find h. (230)

TABLES FOR REFERENCE

Linear Measure or Measures of Length

12 inches (in.) = 1 foot (ft.)
3 feet = 1 yard (yd.)
5.5 yards = 1 rod (rd.)
320 rods or 1760 yards or 5280 feet = 1 mile (mi.)
1 mile = 1.61 kilometres

Square Measure or Measures of Surface

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)
30.25 square yards = 1 square rod (sq. rd.)
160 square rods = 1 acre (A.)
640 acres = 1 square mile (sq. mi.)

Cubic Measure or Measures of Volume

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)
27 cubic feet = 1 cubic yard (cu. yd.)
128 cubic feet = 1 cord of wood of 4-ft. length

Important Volume Equivalents

1 cubic foot = 6¼ gallons (gal.)
1 cubic foot of water = 62.5 pounds (lb.)
1 cubic foot = 0.8 bushel (bu.)
1 gallon = 277.4 cubic inches (cu. in.)

Measures of Weight

16 ounces (oz.) = 1 pound (lb.)
100 pounds = 1 hundredweight (cwt.)
2000 pounds = 1 ton (T.)

Liquid Measures

4 gills (gi.) = 1 pint (pt.)
16 fluid oz. = 1 pint
2 pints = 1 quart (qt.)
4 quarts = 1 gallon (gal.)
31.5 gallons = 1 barrel (bbl.)

Dry Measures

2 pints (pt.) = 1 quart (qt.)
4 quarts = 1 gallon (gal.)
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)
2½ bushels = 1 barrel (bbl.)

Metric Measures of Length and British Equivalents

10 millimetres (mm.) = 1 centimetre (cm.), about .4 inch
10 centimetres = 1 decimetre (dm.), about 4 inches
10 decimetres = 1 metre (m.), nearly 40 inches (39.37)
1000 metres = 1 kilometre (km.), about ⅝ mile

REMEDIAL EXERCISES

Table of Multiplication and Division Facts

The products are found by multiplying the numbers at the top of the columns by each number at the left margin. If each product is divided by the number in its row on the left margin, the quotient will be the number at the top of the column in which the product is found.

	0	1	2	3	4	5	6	7	8	9
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

Addition of Whole Numbers

I.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*
	5	3	1	2	5	1	5	5	7	3	1	5	6	3
	7	5	4	9	7	8	3	4	2	4	4	6	3	9
	8	9	9	4	0	7	7	4	9	3	0	5	5	1
	1	4	6	8	4	9	9	9	4	8	7	8	9	4
	4	7	3	5	9	6	2	7	3	7	6	4	0	8
	6	1	8	6	3	3	6	6	8	6	9	7	8	5

II.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
	54	29	44	28	58	23	36	37	46	59
	38	18	77	76	60	83	29	73	53	44
	72	60	99	54	97	69	18	29	90	72
	96	45	88	32	40	74	70	92	28	80
	75	39	66	90	71	48	55	81	56	67

III.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*
	508	632	736	451	448	382	142	438
	756	108	209	327	376	196	387	196
	349	429	328	964	201	645	960	481
	478	763	157	805	984	528	542	723
	223	548	692	432	538	156	789	645
	194	954	405	198	616	749	150	157

IV.	423	203	96	405	3725	8	903	2758
	56	108	1423	95	946	34	6408	146
	502	706	56	7216	87	729	506	309
	76	1403	9	304	5	1258	807	85
	9	708	145	87	64	635	905	1458
	471	502	32	543	948	74	601	76

Subtraction of Whole Numbers

I.		*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*
	1.	432	561	714	735	541	317	452	372
		118	147	152	128	128	173	191	147
	2.	531	437	448	916	519	643	543	816
		141	182	182	192	138	124	170	125
II.	1.	621	417	734	511	854	912	641	765
		138	259	186	213	196	327	389	197
	2.	547	915	475	811	642	314	547	672
		389	429	197	455	456	198	189	195
III.	1.	760	501	703	580	600	801	504	700
		382	428	209	107	302	108	205	111
	2.	370	502	410	304	702	916	430	504
		190	106	154	196	102	108	102	196

	a	b	c	d	e	f	g	h
IV. 1.	328 72	506 9	712 8	403 9	761 95	46 7	1204 8	316 58
2.	700 3	504 8	324 87	492 78	1400 29	901 18	61 7	371 98

V.	a	b	c	d	e	f	g
1.	4254 4184	9176 9090	7402 7318	5601 5509	1930 1872	8750 8743	2805 2796
2.	5070 4081	7432 7084	6030 5092	8102 7066	5434 5398	7092 7087	4094 4079
VI. 1.	3000 1258	8000 1070	6002 1003	5010 1019	6010 909	4000 1927	7000 28
2.	7090 2095	1000 23	7050 4098	3000 901	5700 4001	5005 4009	6000 5902
3.	40001 3008	50104 1094	80003 70095	50105 40109	10001 909	57000 47009	30303 606

Multiplication of Whole Numbers

I.	a	b	c	d	e	f	g	h
1.	56 7	42 8	531 4	697 5	876 6	963 9	471 8	388 7
2.	987 2	469 8	387 9	459 7	839 6	594 9	689 3	764 8
II. 1.	408 3	706 7	9004 5	1005 6	809 7	903 9	505 4	307 8
2.	5002 2	1902 8	409 9	301 8	7001 7	9008 7	509 8	604 9

III.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*
1.	726	498	546	397	684	756	429	542
	20	60	10	50	80	90	70	30
2.	684	761	936	483	694	761	598	869
	40	80	90	70	800	300	900	700
IV. 1.	836	439	508	907	536	372	408	509
	209	407	508	709	102	609	803	608

	a	*b*	*c*	*d*	*e*	*f*
2.	3004	7004	4261	6035	9087	32456
	206	8006	8001	407	7009	20304

V.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*
1.	670	930	540	610	430	990	870	490
	480	760	290	750	430	740	360	870

	a	*b*	*c*	*d*	*e*	*f*	*g*
2.	840	180	290	740	9640	8070	6090
	370	420	300	900	2070	3090	4080

VI.	*a*	*b*	*c*	*d*	*e*	*f*	*g*
1.	$9.27	$8.56	$4.27	$9.48	$5.14	$9.08	$7.59
	56	97	238	196	807	356	846
2.	963	5698	6941	7635	5096	7498	5487
	479	875	981	674	352	986	873

Division with a One-figure Divisor

I.	*a*	*b*	*c*	*d*	*e*
1.	4)2293	6)3452	9)8749	8)7867	7)5989
2.	5)3476	8)4776	7)69568	6)4757	8)9987

		a	b	c	d	e
II.	1.	9)2012	7)31352	7)3001	6)5019	7)6012
	2.	7)4031	9)21211	7)5100	8)2215	9)31121
	3.	8)50300	6)4101	9)4220	8)21431	7)6124
III.	1.	5)7545	4)9232	6)37248	2)3780	9)7650
	2.	7)51138	8)9645	3)81295	6)96090	5)4900
IV.	1.	4)2963	5)3604	7)3715	2)7401	9)6666
	2.	2)9800	7)5044	9)3158	6)84365	9)72816
	3.	9)9817	8)96360	7)35496	6)96181	8)2004

Division with a Two-or-more-figure Divisor

I.		a	b	c	d	e
	1.	23)496	46)1954	56)3465	97)7004	73)3156
	2.	24)538	33)1066	53)2389	76)3220	44)2379
	3.	43)2754	95)6038	93)4876	65)2925	86)5427

II.		a	b	c	d
	1.	23)4715	42)17031	73)66228	31)39872
	2.	66)39872	98)69193	27)2943	89)80564
	3.	97)4850	78)3900	45)4320	63)1460
III.	1.	96)9072	38)3654	76)7154	86)8235
	2.	47)4405	39)3704	58)5549	44)40052
	3.	78)70678	58)54092	75)7095	58)52548

	a	b	c	d
IV. 1.	48)1642	67)4935	57)2784	88)6853
2.	38)3434	86)2597	49)1785	64)32437
3.	68)7354	78)5280	43)3610	87)6023
V. 1.	24)1842	26)2337	27)1728	39)1628
2.	29)1308	84)7230	99)6935	58)36708
3.	28)1835	59)4232	27)1823	69)3637
VI. 1.	14)972	13)654	17)8540	19)3584
2.	12)9482	14)7856	16)9125	17)5168
3.	16)64325	13)9114	18)4256	19)37254
VII. 1.	412)9467	518)34279	613)17569	318)11468
2.	927)20548	604)27538	709)91486	320)6400
3.	540)10819	403)120907	630)396807	120)49080
VIII. 1.	134)7128	265)8496	374)18523	691)4478
2.	281)8437	290)18763	182)14635	983)83560
3.	372)82680	165)77559	368)29440	150)90060

Addition of Fractions

I.	a	b	c	d	e	f	g
1.	$\frac{3}{4}$ $\frac{3}{4}$	$\frac{5}{6}$ $\frac{5}{6}$	$\frac{4}{9}$ $\frac{8}{9}$	$\frac{11}{12}$ $\frac{7}{12}$	$9\frac{5}{8}$ $6\frac{1}{8}$	$9\frac{1}{4}$ $4\frac{1}{4}$	$7\frac{1}{6}$ $8\frac{1}{6}$
2.	$\frac{7}{10}$ $\frac{9}{10}$	$\frac{11}{12}$ $\frac{5}{12}$	$\frac{3}{8}$ $\frac{5}{8}$	$\frac{4}{9}$ $\frac{5}{9}$	$6\frac{1}{9}$ $4\frac{5}{9}$	$3\frac{5}{8}$ $8\frac{3}{8}$	$9\frac{5}{16}$ $3\frac{7}{16}$

		a	b	c	d	e	f	g
II.	1.	$\frac{1}{4}$ $\frac{5}{8}$	$\frac{3}{4}$ $\frac{11}{12}$	$\frac{5}{6}$ $\frac{2}{3}$	$\frac{2}{5}$ $\frac{7}{10}$	$1\frac{3}{4}$ $2\frac{1}{8}$	$5\frac{1}{4}$ $4\frac{1}{2}$	$1\frac{3}{10}$ $4\frac{2}{5}$
	2.	$\frac{5}{16}$ $\frac{7}{8}$	$\frac{9}{16}$ $\frac{1}{2}$	$\frac{5}{8}$ $\frac{1}{2}$	$\frac{7}{12}$ $\frac{2}{3}$	$9\frac{1}{4}$ $7\frac{5}{12}$	$4\frac{7}{8}$ $3\frac{1}{16}$	$2\frac{5}{6}$ $9\frac{1}{12}$
III.	1.	$\frac{1}{2}$ $\frac{2}{3}$	$\frac{4}{5}$ $\frac{1}{2}$	$\frac{2}{3}$ $\frac{3}{4}$	$\frac{3}{4}$ $\frac{3}{5}$	$8\frac{1}{2}$ $4\frac{1}{3}$	$9\frac{1}{4}$ $7\frac{2}{3}$	$5\frac{1}{4}$ $\frac{1}{3}$
	2.	$\frac{3}{4}$ $\frac{2}{5}$	$\frac{2}{3}$ $\frac{5}{8}$	$\frac{4}{5}$ $\frac{5}{6}$	$\frac{3}{4}$ $\frac{4}{5}$	$9\frac{1}{2}$ $8\frac{1}{5}$	$\frac{4}{9}$ $3\frac{1}{2}$	$7\frac{1}{3}$ $8\frac{1}{4}$
IV.	1.	$\frac{3}{4}$ $\frac{1}{6}$	$\frac{7}{8}$ $\frac{5}{6}$	$\frac{5}{9}$ $\frac{1}{6}$	$\frac{3}{8}$ $\frac{5}{6}$	$2\frac{1}{4}$ $8\frac{1}{6}$	$7\frac{3}{4}$ $\frac{1}{6}$	$2\frac{1}{8}$ $3\frac{1}{6}$
	2.	$\frac{7}{9}$ $\frac{5}{6}$	$\frac{7}{8}$ $\frac{5}{12}$	$\frac{3}{8}$ $\frac{11}{12}$	$\frac{7}{10}$ $\frac{5}{6}$	$8\frac{1}{9}$ $5\frac{1}{6}$	$7\frac{3}{8}$ $\frac{5}{12}$	$6\frac{1}{10}$ $\frac{5}{6}$
V.	1.	$4\frac{2}{3}$ $1\frac{3}{4}$	$9\frac{4}{5}$ $6\frac{1}{2}$	$7\frac{1}{3}$ $\frac{3}{4}$	$8\frac{3}{4}$ $4\frac{3}{5}$	$6\frac{1}{2}$ $7\frac{2}{3}$	$5\frac{1}{2}$ $4\frac{3}{5}$	$6\frac{8}{9}$ $9\frac{1}{2}$
	2.	$1\frac{5}{8}$ $\frac{2}{3}$	$6\frac{3}{4}$ $\frac{2}{5}$	$9\frac{4}{7}$ $4\frac{1}{2}$	$3\frac{6}{7}$ $\frac{1}{2}$	$7\frac{2}{3}$ $1\frac{7}{8}$	$9\frac{1}{2}$ $\frac{7}{9}$	$5\frac{8}{9}$ $\frac{1}{2}$
VI.	1.	$2\frac{3}{4}$ $1\frac{5}{6}$	$9\frac{7}{8}$ $4\frac{5}{6}$	$6\frac{3}{8}$ $4\frac{5}{6}$	$9\frac{7}{12}$ $4\frac{5}{8}$	$7\frac{5}{9}$ $2\frac{5}{6}$	$4\frac{5}{6}$ $\frac{7}{10}$	$3\frac{7}{8}$ $\frac{1}{6}$
	2.	$8\frac{9}{10}$ $4\frac{1}{4}$	$6\frac{5}{8}$ $1\frac{7}{12}$	$9\frac{8}{9}$ $4\frac{5}{6}$	$3\frac{11}{12}$ $\frac{5}{8}$	$4\frac{3}{10}$ $\frac{5}{6}$	$6\frac{3}{10}$ $\frac{3}{4}$	$4\frac{5}{6}$ $7\frac{7}{9}$
VII.	1.	$3\frac{1}{2}$ $4\frac{5}{6}$ $9\frac{7}{12}$	$8\frac{1}{4}$ $5\frac{3}{8}$ $7\frac{1}{2}$	$6\frac{5}{12}$ $\frac{3}{4}$ $4\frac{2}{3}$	$9\frac{1}{8}$ $\frac{7}{16}$ $11\frac{3}{4}$	$2\frac{1}{2}$ $\frac{3}{4}$ $\frac{5}{16}$	$8\frac{3}{4}$ 7 $4\frac{7}{12}$	$9\frac{1}{4}$ $2\frac{1}{2}$ $6\frac{3}{8}$
	2.	$14\frac{1}{8}$ $9\frac{1}{4}$ $27\frac{1}{2}$	$5\frac{1}{4}$ $4\frac{7}{12}$ 13	$6\frac{3}{8}$ $9\frac{7}{16}$ $14\frac{1}{2}$	$3\frac{2}{3}$ $6\frac{1}{2}$ $9\frac{1}{6}$	$7\frac{5}{9}$ $4\frac{2}{3}$ $6\frac{8}{9}$	$7\frac{4}{5}$ $8\frac{1}{2}$ $6\frac{3}{10}$	$17\frac{2}{3}$ $1\frac{7}{12}$ $19\frac{1}{2}$

	a	*b*	*c*	*d*	*e*	*f*	*g*
VIII. 1.	$5\frac{2}{3}$ $\frac{3}{4}$ $7\frac{1}{6}$	$9\frac{1}{8}$ $\frac{3}{4}$ $2\frac{5}{6}$	$4\frac{1}{8}$ 9 $2\frac{5}{6}$	$4\frac{5}{6}$ $3\frac{7}{9}$ $8\frac{1}{2}$	$7\frac{2}{3}$ $1\frac{5}{6}$ $\frac{8}{9}$	$7\frac{1}{4}$ $\frac{1}{6}$ $15\frac{1}{2}$	11 $2\frac{3}{8}$ $6\frac{1}{6}$
2.	$\frac{3}{8}$ $\frac{2}{3}$ $4\frac{1}{2}$	$5\frac{3}{4}$ $6\frac{2}{3}$ $7\frac{1}{8}$	$9\frac{1}{4}$ $2\frac{5}{6}$ $4\frac{2}{3}$	$2\frac{3}{8}$ $\frac{1}{6}$ $7\frac{3}{4}$	$5\frac{7}{10}$ $\frac{3}{5}$ $2\frac{1}{4}$	$1\frac{4}{9}$ $5\frac{1}{6}$ $3\frac{1}{2}$	$8\frac{1}{10}$ $4\frac{1}{2}$ $\frac{3}{4}$

Subtraction of Fractions

	a	*b*	*c*	*d*	*e*	*f*	*g*
I. 1.	$\frac{7}{8}$ $\frac{1}{2}$	$\frac{5}{6}$ $\frac{2}{3}$	$\frac{7}{8}$ $\frac{3}{4}$	$\frac{9}{12}$ $\frac{2}{3}$	$8\frac{1}{2}$ $5\frac{1}{4}$	$9\frac{5}{6}$ $1\frac{2}{3}$	$14\frac{7}{9}$ $5\frac{2}{3}$
2.	$\frac{15}{16}$ $\frac{3}{8}$	$\frac{11}{12}$ $\frac{5}{6}$	$\frac{9}{10}$ $\frac{1}{5}$	$\frac{7}{8}$ $\frac{5}{16}$	$17\frac{1}{2}$ $9\frac{1}{8}$	$13\frac{3}{4}$ $7\frac{1}{2}$	$14\frac{3}{8}$ $5\frac{1}{16}$
II. 1.	$\frac{5}{6}$ $\frac{1}{2}$	$\frac{5}{6}$ $\frac{1}{3}$	$\frac{7}{12}$ $\frac{1}{3}$	$\frac{11}{12}$ $\frac{1}{4}$	$19\frac{5}{6}$ $11\frac{1}{2}$	$6\frac{9}{10}$ $\frac{1}{2}$	$7\frac{5}{12}$ $\frac{1}{4}$
2.	$\frac{1}{2}$ $\frac{1}{6}$	$\frac{1}{2}$ $\frac{1}{10}$	$\frac{11}{12}$ $\frac{2}{3}$	$\frac{11}{12}$ $\frac{3}{4}$	$9\frac{1}{2}$ $4\frac{1}{10}$	$17\frac{1}{3}$ $9\frac{1}{12}$	$11\frac{3}{4}$ $8\frac{1}{12}$
III. 1.	$\frac{3}{4}$ $\frac{1}{5}$	$\frac{2}{3}$ $\frac{1}{4}$	$\frac{5}{6}$ $\frac{1}{4}$	$\frac{7}{8}$ $\frac{5}{6}$	$9\frac{1}{2}$ $2\frac{1}{3}$	$11\frac{3}{4}$ $4\frac{2}{3}$	$17\frac{1}{4}$ $9\frac{1}{6}$
2.	$\frac{5}{6}$ $\frac{5}{8}$	$\frac{5}{6}$ $\frac{5}{9}$	$\frac{7}{10}$ $\frac{1}{4}$	$\frac{4}{5}$ $\frac{2}{3}$	$9\frac{1}{3}$ $9\frac{1}{4}$	$5\frac{3}{4}$ $\frac{2}{3}$	$1\frac{4}{5}$ $\frac{1}{2}$
IV. 1.	9 $4\frac{3}{4}$	6 $5\frac{2}{3}$	7 $\frac{2}{3}$	1 $\frac{5}{6}$	11 $4\frac{7}{8}$	15 $9\frac{5}{7}$	14 $7\frac{8}{9}$
2.	17 $9\frac{4}{5}$	1 $\frac{11}{12}$	14 $8\frac{1}{2}$	12 $5\frac{4}{9}$	13 $3\frac{1}{6}$	15 $5\frac{1}{2}$	16 $4\frac{1}{4}$

	a	b	c	d	e	f	g
V. 1.	$6\frac{1}{4}$ $2\frac{3}{4}$	$8\frac{1}{3}$ $5\frac{2}{3}$	$7\frac{1}{6}$ $4\frac{5}{6}$	$6\frac{4}{9}$ $5\frac{7}{9}$	$9\frac{1}{8}$ $4\frac{5}{8}$	$17\frac{1}{5}$ $9\frac{4}{5}$	$7\frac{1}{2}$ $4\frac{1}{2}$
2.	$11\frac{3}{8}$ $9\frac{5}{8}$	$12\frac{1}{12}$ $5\frac{7}{12}$	$9\frac{5}{16}$ $4\frac{11}{16}$	$13\frac{7}{8}$ $4\frac{15}{16}$	$9\frac{5}{9}$ $8\frac{8}{9}$	$11\frac{3}{8}$ $9\frac{7}{8}$	$14\frac{9}{16}$ $7\frac{15}{16}$
VI. 1.	$7\frac{1}{2}$ $4\frac{3}{4}$	$9\frac{2}{3}$ $\frac{5}{6}$	$10\frac{3}{4}$ $1\frac{7}{8}$	$7\frac{5}{12}$ $\frac{5}{6}$	$9\frac{1}{4}$ $\frac{15}{16}$	$1\frac{3}{4}$ $\frac{11}{12}$	$1\frac{1}{2}$ $\frac{5}{6}$
2.	$9\frac{1}{4}$ $8\frac{1}{2}$	$12\frac{5}{6}$ $4\frac{11}{12}$	$13\frac{1}{2}$ $4\frac{13}{16}$	$2\frac{1}{2}$ $1\frac{7}{8}$	$1\frac{1}{2}$ $\frac{7}{10}$	$14\frac{1}{10}$ $7\frac{2}{5}$	$6\frac{1}{6}$ $\frac{5}{12}$
VII. 1.	$2\frac{1}{2}$ $1\frac{2}{3}$	$1\frac{1}{4}$ $\frac{1}{3}$	$14\frac{1}{2}$ $7\frac{2}{3}$	$6\frac{2}{3}$ $5\frac{3}{4}$	$9\frac{1}{2}$ $7\frac{4}{5}$	$1\frac{1}{3}$ $\frac{3}{4}$	$14\frac{2}{3}$ $7\frac{4}{5}$
2.	$7\frac{1}{5}$ $6\frac{3}{4}$	$8\frac{1}{4}$ $7\frac{4}{5}$	$1\frac{1}{2}$ $\frac{4}{5}$	$1\frac{1}{3}$ $\frac{2}{5}$	$15\frac{1}{9}$ $7\frac{1}{2}$	$13\frac{1}{2}$ $5\frac{7}{9}$	$14\frac{4}{9}$ $8\frac{1}{2}$
VIII. 1.	$12\frac{3}{4}$ $4\frac{5}{6}$	$9\frac{1}{6}$ $2\frac{3}{4}$	$11\frac{3}{8}$ $1\frac{5}{6}$	$1\frac{5}{6}$ $\frac{7}{8}$	$12\frac{1}{9}$ $3\frac{5}{6}$	$14\frac{1}{6}$ $2\frac{7}{9}$	$13\frac{5}{8}$ $\frac{11}{12}$
2.	$15\frac{1}{4}$ $4\frac{7}{10}$	$8\frac{1}{10}$ $2\frac{3}{4}$	$9\frac{1}{6}$ $4\frac{7}{10}$	$16\frac{7}{10}$ $7\frac{5}{6}$	$13\frac{1}{10}$ $8\frac{1}{6}$	$12\frac{1}{10}$ $9\frac{1}{4}$	$1\frac{1}{6}$ $\frac{7}{8}$

Multiplication of Fractions

	a	b	c	d	e
I. 1.	$\frac{3}{4} \times 5$	$\frac{7}{8} \times 9$	$\frac{5}{6} \times 7$	$\frac{2}{3} \times 8$	$\frac{1}{8} \times 3$
2.	$\frac{2}{9} \times 2$	$\frac{4}{5} \times 12$	$\frac{9}{10} \times 3$	$\frac{3}{7} \times 16$	$\frac{2}{3} \times 26$
3.	$\frac{1}{2} \times 57$	$\frac{2}{3} \times 95$	$\frac{3}{5} \times 27$	$\frac{1}{9} \times 8$	$\frac{5}{9} \times 50$
II. 1.	$\frac{3}{8} \times 12$	$\frac{5}{9} \times 6$	$\frac{7}{8} \times 20$	$\frac{5}{6} \times 15$	$\frac{7}{12} \times 30$
2.	$\frac{9}{16} \times 24$	$\frac{5}{16} \times 50$	$\frac{7}{10} \times 25$	$\frac{1}{6} \times 40$	$\frac{8}{9} \times 60$
3.	$\frac{3}{4} \times 26$	$\frac{3}{10} \times 36$	$\frac{7}{12} \times 45$	$\frac{5}{6} \times 75$	$\frac{3}{8} \times 50$
III. 1.	$6 \times \frac{5}{12}$	$9 \times \frac{7}{15}$	$8 \times \frac{1}{4}$	$12 \times \frac{3}{4}$	$56 \times \frac{7}{8}$
2.	$24 \times \frac{5}{16}$	$18 \times \frac{5}{6}$	$30 \times \frac{7}{10}$	$15 \times \frac{5}{6}$	$24 \times \frac{8}{9}$
3.	$12 \times \frac{7}{8}$	$20 \times \frac{5}{8}$	$15 \times \frac{7}{12}$	$36 \times \frac{3}{8}$	$48 \times \frac{11}{16}$

		a	b	c	d	e
IV.	1.	$2\frac{1}{2} \times 14$	$3\frac{1}{4} \times 50$	$7\frac{2}{3} \times 18$	$9\frac{5}{6} \times 27$	$8\frac{1}{4} \times 50$
	2.	$4\frac{1}{4} \times 26$	$3\frac{7}{8} \times 48$	$5\frac{1}{6} \times 45$	$7\frac{1}{3} \times 42$	$5\frac{1}{7} \times 18$
	3.	$4\frac{3}{8} \times 60$	$11\frac{1}{2} \times 35$	$6\frac{7}{8} \times 36$	$5\frac{3}{8} \times 38$	$9\frac{1}{2} \times 56$
V.	1.	$\frac{2}{3} \times \frac{1}{5}$	$\frac{4}{5} \times \frac{3}{7}$	$\frac{5}{6} \times \frac{7}{8}$	$\frac{1}{2} \times \frac{9}{10}$	$\frac{3}{4} \times \frac{9}{16}$
	2.	$\frac{1}{4} \times \frac{5}{8}$	$\frac{2}{3} \times \frac{7}{9}$	$\frac{5}{8} \times \frac{5}{9}$	$\frac{1}{6} \times \frac{1}{4}$	$\frac{2}{3} \times \frac{5}{7}$
	3.	$\frac{7}{9} \times \frac{5}{6}$	$\frac{1}{9} \times \frac{1}{3}$	$\frac{3}{4} \times \frac{9}{16}$	$\frac{1}{2} \times \frac{11}{16}$	$\frac{5}{8} \times \frac{9}{16}$
VI.	1.	$\frac{2}{3} \times \frac{3}{4}$	$\frac{5}{6} \times \frac{9}{10}$	$\frac{3}{4} \times \frac{8}{9}$	$2\frac{1}{2} \times \frac{7}{10}$	$1\frac{1}{4} \times \frac{6}{7}$
	2.	$\frac{7}{9} \times \frac{3}{4}$	$\frac{5}{8} \times \frac{4}{5}$	$2\frac{3}{4} \times \frac{8}{11}$	$\frac{5}{6} \times 2\frac{1}{4}$	$5\frac{1}{3} \times \frac{7}{8}$
	3.	$\frac{1}{4} \times \frac{8}{9}$	$\frac{11}{12} \times \frac{3}{4}$	$\frac{1}{10} \times \frac{5}{8}$	$1\frac{1}{8} \times \frac{8}{9}$	$\frac{5}{12} \times 5\frac{1}{4}$

		a	b	c	d
VII.	1.	$5\frac{1}{4} \times 6\frac{2}{3}$	$7\frac{2}{3} \times 8\frac{1}{4}$	$1\frac{1}{2} \times 2\frac{1}{4}$	$5\frac{1}{4} \times 4\frac{1}{9}$
	2.	$2\frac{1}{2} \times 2\frac{1}{2}$	$3\frac{1}{3} \times 4\frac{1}{2}$	$5\frac{1}{4} \times 3\frac{1}{7}$	$2\frac{3}{8} \times 1\frac{1}{3}$
	3.	$6\frac{1}{4} \times 4\frac{2}{5}$	$12\frac{1}{2} \times 3\frac{1}{10}$	$3\frac{1}{7} \times 8\frac{3}{4}$	$6\frac{7}{8} \times 2\frac{4}{11}$

		a	b	c
VIII.	1.	$2\frac{1}{2} \times 3\frac{1}{4} \times 6$	$8 \times 1\frac{1}{3} \times 2\frac{5}{6}$	$7\frac{1}{2} \times 3 \times 4\frac{2}{3}$
	2.	$1\frac{1}{4} \times 5 \times 6\frac{7}{8}$	$3\frac{1}{2} \times 1\frac{1}{4} \times 4\frac{1}{2}$	$9 \times 1\frac{5}{6} \times 2\frac{1}{2}$
	3.	$2\frac{1}{4} \times 2 \times \frac{3}{8}$	$\frac{5}{8} \times 1\frac{1}{4} \times 1\frac{1}{3}$	$3\frac{1}{7} \times 2\frac{1}{2} \times 1\frac{3}{4}$

Division of Fractions

		a	b	c	d	e
I.	1.	$\frac{1}{2} \div 2$	$\frac{2}{3} \div 3$	$\frac{3}{4} \div 5$	$\frac{7}{8} \div 2$	$\frac{9}{10} \div 2$
	2.	$\frac{3}{7} \div 2$	$\frac{3}{10} \div 4$	$\frac{6}{7} \div 5$	$\frac{1}{8} \div 3$	$\frac{3}{4} \div 2$
	3.	$\frac{1}{9} \div 2$	$\frac{8}{9} \div 3$	$\frac{11}{12} \div 2$	$\frac{5}{16} \div 2$	$\frac{1}{16} \div 3$
II.	1.	$\frac{3}{8} \div 3$	$\frac{4}{7} \div 2$	$\frac{5}{9} \div 5$	$\frac{6}{7} \div 3$	$\frac{9}{10} \div 3$
	2.	$\frac{6}{7} \div 4$	$\frac{8}{9} \div 6$	$\frac{9}{10} \div 6$	$\frac{8}{11} \div 4$	$\frac{9}{16} \div 3$
	3.	$\frac{3}{7} \div 3$	$\frac{4}{9} \div 6$	$\frac{10}{11} \div 5$	$\frac{7}{8} \div 7$	$\frac{5}{6} \div 10$
III.	1.	$12 \div \frac{2}{3}$	$12 \div \frac{3}{4}$	$18 \div \frac{3}{8}$	$9 \div \frac{1}{2}$	$7 \div \frac{1}{6}$
	2.	$11 \div \frac{3}{4}$	$8 \div \frac{5}{6}$	$7 \div \frac{2}{3}$	$6 \div \frac{3}{8}$	$10 \div \frac{3}{4}$
	3.	$36 \div \frac{3}{4}$	$96 \div \frac{8}{9}$	$9 \div \frac{3}{4}$	$21 \div \frac{3}{7}$	$15 \div \frac{2}{3}$
IV.	1.	$\frac{2}{3} \div \frac{5}{8}$	$\frac{3}{4} \div \frac{4}{9}$	$\frac{1}{2} \div \frac{2}{3}$	$\frac{2}{3} \div \frac{5}{8}$	$\frac{3}{4} \div \frac{2}{9}$
	2.	$\frac{9}{10} \div \frac{5}{7}$	$\frac{5}{6} \div \frac{6}{7}$	$\frac{3}{5} \div \frac{4}{9}$	$\frac{1}{3} \div \frac{1}{2}$	$\frac{1}{2} \div \frac{1}{3}$

		a	*b*	*c*	*d*	*e*
V.	1.	$6 \div 1\frac{1}{3}$	$7 \div 3\frac{1}{2}$	$9 \div 4\frac{1}{2}$	$1 \div 2\frac{1}{2}$	$14 \div 2\frac{1}{3}$
	2.	$2 \div 1\frac{1}{2}$	$8 \div 4\frac{1}{4}$	$12 \div 2\frac{2}{5}$	$36 \div 3\frac{1}{7}$	$15 \div 3\frac{3}{4}$
	3.	$1 \div 3\frac{1}{3}$	$60 \div 6\frac{2}{3}$	$28 \div 3\frac{1}{7}$	$40 \div 3\frac{1}{3}$	$5 \div 1\frac{1}{4}$
VI.	1.	$1\frac{1}{2} \div 2\frac{1}{4}$	$2\frac{1}{3} \div 4\frac{2}{3}$	$9\frac{1}{6} \div 3\frac{1}{2}$	$8\frac{1}{4} \div 1\frac{7}{8}$	$5\frac{1}{9} \div 1\frac{1}{3}$
	2.	$4\frac{1}{2} \div 2\frac{1}{4}$	$6\frac{1}{2} \div 3\frac{1}{7}$	$9\frac{1}{4} \div 2\frac{1}{8}$	$5\frac{1}{3} \div 2\frac{2}{3}$	$1\frac{7}{8} \div 2\frac{1}{2}$
	3.	$9\frac{1}{3} \div 5\frac{1}{6}$	$8\frac{1}{2} \div 4\frac{1}{4}$	$15\frac{1}{3} \div 1\frac{1}{6}$	$12\frac{1}{2} \div 1\frac{2}{3}$	$7\frac{1}{3} \div 1\frac{3}{4}$
VII.	1.	$3 \div 4$	$5 \div 6$	$7 \div 8$	$9 \div 12$	$15 \div 30$
	2.	$1 \div 8$	$7 \div 10$	$5 \div 15$	$24 \div 36$	$48 \div 72$

Addition of Decimals

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*
I.	1.	.3	.1	.1	.7	.3	.2	.1	.5	.8	.5	.6	.4
		.8	.2	.2	.4	.9	.6	.3	.4	.6	.9	.8	.3
		.6	.1	.1	.6	.5	.7	.2	.7	.9	4	.6	.5
		.7	.3	.2	.9	.4	.9	.4	.4	.2	.3	.5	.9

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
II.	1.	.03	.01	.02	.48	.30	40	.38	.47	.29
		.05	.02	.04	.28	.50	.60	.27	.23	.38
		.06	.01	.01	.36	.70	.70	.54	.56	.54
		.07	.04	.03	.16	.50	.90	.96	.84	.72
III.	1.	5.6	0.8	3.9	9.1	3.1	7.2	3.5	4.0	1.5
		4.3	7.6	0.8	7.4	0.4	2.8	4.8	1.9	0.5
		7.2	3.1	7.4	5.8	0.9	5.4	1.2	7.3	2.0
		9.4	1.5	5.2	6.7	0.6	9.7	0.9	5.5	3.5

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
IV.	1.	4.32	2.60	5.65	5.28	.450	.426	1.46	.743
		1.56	0.90	1.78	3.76	.390	.380	2.70	.192
		9.38	7.30	8.46	1.45	.545	.725	9.88	.085
		6.27	2.80	3.27	0.87	.025	.940	5.07	.388
		5.34	1.50	0.96	6.20	.790	.385	3.96	.959

Subtraction of Decimals

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
I.	1.	.45	.53	.90	.50	.31	.90	.80	.625	.600
		.25	.18	.45	.46	.15	.57	.73	.145	.492
II.	1.	3.4	5.0	7.2	9.4	5.3	6.8	1.0	5.4	6.0
		1.2	1.6	6.2	8.6	4.7	1.9	0.3	1.9	5.9

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
III.	1.	7.20	3.00	1.00	5.40	9.05	4.50	7.61	3.80	8.04
		4.85	1.90	0.39	0.78	8.05	4.39	2.59	3.76	7.96

		a	*b*	*c*	*d*	*e*	*f*	*g*
IV.	1.	4.90	3.00	9.56	2.75	5.46	1.730	2.840
		1.09	2.75	1.56	2.75	2.86	0.930	1.940
	2.	7.00	3.04	7.36	1.01	12.38	13.450	14.325
		4.01	2.94	1.89	0.99	4.96	7.580	8.105

Multiplication of Decimals

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
I.	1.	.47	.58	3.6	5.8	.96	.78	.89	9.4	3.4
		2	5	4	9	8	3	6	7	8
II.	1.	.01	.07	.04	.07	3.01	4.02	7.04	9.03	6.07
		9	8	7	9	4	6	5	8	9
III.	1.	76	38	25	68	43	57	78	96	39
		.4	.9	.4	.7	.5	.6	.5	.04	.08
	2.	13	49	56	94	75	460	380	965	430
		.07	.08	.05	.08	.06	.05	.04	.07	.09

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
IV.	1.	6.2	5.4	2.5	9.6	5.8	9.6	43.7	5.38	37.5
		3.8	2.5	2.5	4.7	1.3	2.1	4.8	2.6	8.4

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
2.	2.9	6.4	3.9	5.5	7.26	6.04	50.5	3.12	5.39
	2.9	5.8	1.9	3.4	1.8	3.5	9.6	1.7	2.8

V. 1.	.84	.75	3.8	5.04	.39	.06	.025	.035	8.35
	.02	.04	.04	.07	.02	.04	.25	.35	.57
2.	.09	.16	.15	.14	.56	3.01	8.75	4.56	.736
	.01	.16	.15	.08	.04	.19	.65	.028	.095

VI. Multiply each of the following by 10, 100, and 1000:

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
1.	3.5	7.86	.946	.035	72.6	.548	.0755	1.05
2.	.001	5.4	7.86	.009	.078	3.56	4.25	0.38

Division of Decimals

I.	*a*	*b*	*c*	*d*	*e*
1.	$6\overline{)9.6}$	$7\overline{)12.6}$	$2\overline{)9.2}$	$8\overline{)3.28}$	$5\overline{)4.45}$
2.	$4\overline{)13.6}$	$9\overline{)2.16}$	$7\overline{).84}$	$6\overline{)39.54}$	$8\overline{)1.384}$
II. 1.	$3\overline{).216}$	$2\overline{).196}$	$4\overline{).376}$	$5\overline{).1375}$	$9\overline{).4806}$
2.	$7\overline{).294}$	$8\overline{).608}$	$7\overline{).1337}$	$4\overline{).092}$	$8\overline{).096}$
III. 1.	$.3\overline{)72}$	$.5\overline{)40}$	$.7\overline{)91}$	$.6\overline{)84}$	$.9\overline{)126}$
2.	$.2\overline{)98}$	$.3\overline{)57}$	$.5\overline{)67}$	$.8\overline{)124}$	$.4\overline{)78}$

IV.	*a*	*b*	*c*	*d*	*e*
1.	$.02\overline{)31}$	$.03\overline{)51}$	$.05\overline{)18}$	$.07\overline{)567}$	$.15\overline{)225}$
2.	$.08\overline{)37}$	$.09\overline{)162}$	$.48\overline{)2256}$	$.75\overline{)3150}$	$.54\overline{)2592}$

		a	b	c	d	e
V.	1.	.2)9.4	.3).54	.6).912	.8)1.28	.9).729
	2.	.3)8.1	.8).624	.5).0295	.4)7.6	.7).0644
	3.	.02).58	.06)3.48	.15).645	.24).408	.45)166.5
	4.	.01)9.8	.08)1.2	.14).532	.36)1.368	.64).2112
VI.	1.	12).06	18).09	75).03	16).8	36).018
	2.	25).08	15).006	14).7	75).6	35).014
	3.	16).12	36).27	38).019	54).27	34).051

VII.	a	b	c	d	e	f	g
1.	4)3	8)1	5)3	4)1	8)3	5)4	16)1
2.	8)7	2)1	36)27	12)9	16)10	24)18	25)4
3.	25)9	40)11	20)17	24)9	14)7	26)13	25)24

VIII.	a	b	c	d
1.	1.6).336	.34).0918	4.6)119.6	.64)1.728
2.	4.8)18.24	.75)352.5	2.7).0999	6.9)248.4
3.	.18).0882	3.6).1656	8.3).3901	.94)441.8
4.	7.6)3.496	.48).2256	1.7).0816	.12).0588
5.	.19).0912	.37)177.6	.55).3685	.42).3108

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